Consultation Number: F/NWR/2004/00825

Biological Opinion on Impacts of Treaty Indian and Non-Indian Fall Season Fisheries in the Columbia River Basin in Year 2004, on Salmon and Steelhead Listed Under the Endangered Species Act.

Action Agency: National Marine Fisheries Service (NMFS)

Species/Evolutionarily Significant Units Affected:

Species	Evolutionarily Significant Unit	Status	Federal Register Notice	
Chinook Salmon (*Oncorhynchus tshawytscha*)	Snake River Fall Lower Columbia River	Threatened Threatened	57 FR 14653 64 FR 14308	4/22/92 3/24/99
Chum Salmon (*O. Keta*)	Columbia River	Threatened	64 FR 14570	3/25/99
Coho Salmon (*O. Kisutch*)	Lower Columbia River	Proposed as Threatened	69 FR 33102	6/14/04
Steelhead (*O. mykiss*)	Upper Columbia River Snake River Basin Lower Columbia River Middle Columbia River	Endangered Threatened Threatened Threatened	62 FR 43937 62 FR 43937 63 FR 13347 64 FR 14517	8/18/97 8/18/97 3/19/98 3/25/99

Activities considered: To conduct fisheries proposed for the year 2004 fall season in the Columbia River Basin by the States of Oregon and Washington, the Nez Perce Tribe, the Confederated Tribes of the Umatilla Indian Reservation, the Confederated Tribes of the Warm Springs Reservation of Oregon, and the Yakama Indian Nation.

Consultation conducted by: NMFS, Sustainable Fisheries Division, Northwest Region.
Consultation Number: F/NWR/2004/00825

The U.S. v Oregon parties propose to enter into a one year agreement regarding the 2004 fall season fisheries (U.S. v Oregon parties 2004). In this biological opinion, NMFS reviews information regarding the impacts to listed fish associated with the proposed fisheries. The Incidental Take Statement will set the limits of allowable take. This biological opinion has been prepared in accordance with section 7 of the Endangered Species Act (ESA), as amended (16 U.S.C. 1531 et seq.). A complete administrative record of this consultation is on file with NMFS, Sustainable Fisheries Division in Seattle, Washington.

Approved by: D. Robert Lohn
D. Robert Lohn, Regional Administrator

Date: 8/6/04

[Expires on: DEC 31 2004**]**

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INTRODUCTION

The National Marine Fisheries Service (NMFS) is required under section 7 of the ESA to conduct a consultation that considers the impacts of proposed fall season salmon fisheries on species listed under the ESA. The proposed fisheries are to be conducted pursuant to the "2004 Management Agreement for Upper Columbia River Fall Chinook, Steelhead and Coho," which the parties propose to have entered as a court order in the case of U.S. v Oregon. The parties to the proposed 2004 Management Agreement are: the States of Oregon, Washington and Idaho, the Nez Perce Tribe, the Confederated Tribes of the Umatilla Indian Reservation, the Confederated Tribes of the Warm Springs Reservation of Oregon, the Yakama Indian Nation, The Shoshone-Bannock Tribes, the Bureau of Indian Affairs, the U.S. Fish and Wildlife Service and the National Marine Fisheries Service (hereafter referred to as "Parties.") This biological opinion considers the effects of fisheries proposed in the agreement for the year 2004 in the Columbia River Basin by the States of Oregon and Washington, the Nez Perce Tribe, the Confederated Tribes of the Umatilla Indian Reservation, the Confederated Tribes of the Warm Springs Reservation of Oregon, and the Yakama Indian Nation. The ESA listed species in the action area that are potentially affected by the proposed fisheries include: Snake River fall and Lower Columbia River chinook salmon; Columbia River chum salmon, and Upper Columbia River, Snake River, Lower Columbia River, and Middle Columbia River steelhead. Lower Columbia River coho salmon are proposed for listing as threatened under the ESA and may be affected by the proposed fisheries. NMFS is therefore also conducting a conference pursuant to section 7 of the ESA regarding the impacts of proposed fisheries on Lower Columbia River coho salmon.

CONSULTATION HISTORY

Fisheries in the Columbia River basin were managed subject to provisions of the Columbia River Fish Management Plan (CRFMP) from 1988 through 1998. The CRFMP was a stipulated agreement adopted by the Federal Court under the continuing jurisdiction of U.S. v Oregon. NMFS has provided consultation under section 7 of the ESA on proposed fisheries in the Columbia basin since 1992 when affected salmonids were first listed. The Technical Advisory Committee (TAC) of U.S. v Oregon routinely prepared biological assessments for proposed fisheries that were submitted to NMFS through the U.S. Fish and Wildlife Service (USFWS). The TAC biological assessments considered treaty Indian and non-Indian fisheries within the jurisdiction of the CRFMP, with the exception of Idaho fisheries in the Snake River Basin, which were considered separately under section 10 of the ESA.

Fall season fisheries in the Columbia River basin were managed from 1996-1998 under provisions of the 1996-1998 Management Agreement for Upper Columbia River Fall Chinook. This management agreement modified provisions of the CRFMP to include specific guidelines for the management of Snake River fall chinook. NMFS issued a biological opinion on the fall season fisheries under the terms of the three year agreement (NMFS 1996). NMFS then reinitiated consultation in 1998 to consider additional management measures for the protection of newly listed steelhead species and issued a biological opinion that covered just the 1998 fall season fisheries (NMFS 1998).

The CRFMP expired on December 31, 1998, but was extended by court order through July 31, 1999. The Plan expired thereafter. The 1999 fall season fisheries were managed pursuant to a one-year agreement between the state, tribal and Federal parties to U.S. v Oregon. The proposed state and tribal fisheries in the1999 management agreement were considered through a section 7 consultation. The Federal government's participation in that agreement was the Federal action that provided the necessary nexus for consultation under section 7 of the ESA.

The consultation processes leading up to each of the 2000 and 2001 fisheries were similar. In both years the process of the consultation for the fall season fisheries was initially unclear. At the outset there was no agreement among the parties regarding fall fisheries, particularly with respect to allocation. Absent an agreement or other recognizable Federal action, there was no nexus for authorizing proposed state fisheries under section 7, and NMFS advised the states of Oregon and Washington that they should apply for a section 10 permit. Although the states disagreed with NMFS on the question of nexus for the state fisheries, they nonetheless submitted a section 10 permit applications for consideration of their fall season fisheries in 2000 and 2001 (Greer and Koenings 2000a, Norman and Tweit 2001). In 2000 and 2001, the Bureau of Indian Affairs initiated section 7 consultation on behalf of the tribes by providing biological assessments to NMFS regarding the tribes' proposed fall season fisheries (Jamison 2000, Overberg 2001).

Initially, in 2000 and 2001, the state and tribal fisheries were analyzed separately using the section 7 and 10 processes. However, prior to completion of the consultation, the U.S. v Oregon parties resolved outstanding issues and concluded annual agreements regarding management of the 2000 and 2001 fall season fisheries (U.S. v Oregon Parties 2000, 2001). As was the case in 1999, these agreements among the state, tribal, and Federal parties provided a nexus for NMFS' consideration of the combined state and tribal fisheries through a single section 7 consultation. The states and tribes subsequently requested that their initial proposals be considered as part of a joint action pursuant to the annual fall agreements, and provided updates where necessary to clarify the magnitude of impacts that would be associated with their now revised fishery proposals (Greer and Koenings 2000b, U.S. v Oregon Parties 2001).

In 2002 and 2003, the parties concluded an agreement regarding the fall season fisheries, which is described in the 2002 and 2003 biological assessments prepared by TAC (LeFleur 2002 and 2003). The 2002 and 2003 management agreement (U.S. v Oregon Parties 2002, and 2003) among the state, tribal, and Federal parties provided a nexus for NMFS' consideration of the proposed fisheries under section 7 of the ESA.

In 2004, the parties have negotiated a one-year management agreement regarding the fall season fisheries, which are described in the 2004 biological assessment prepared by TAC (LeFleur 2004). The 2004 management agreement (U.S. v Oregon Parties 2004) among the state, tribal, and Federal parties provides a nexus for NMFS' consideration of the proposed fisheries under section 7 of the ESA.

BIOLOGICAL OPINION

1.0 DESCRIPTION OF THE PROPOSED ACTION

1.1 Proposed Action

The Federal action considered in this biological opinion is implementation of the fisheries in the 2004 management agreement (LeFleur 2004). The non-Indian fisheries proposed by the states of Oregon and Washington extend from August 1, 2004 to December 31, 2004 in the Columbia River mainstem from its mouth to Priest Rapids Dam and to Ice Harbor Dam on the Snake River. Non-Indian fisheries addressed in this biological opinion include mainstem sport fisheries for salmonids from Buoy 10 upstream to Priest Rapids Dam, commercial fisheries for salmon and sturgeon from the Columbia River mouth to Bonneville Dam, sport sturgeon and warmwater fisheries from the Columbia River mouth to Priest Rapids Dam, Wanapum tribal fisheries downstream from Priest Rapids Dam, steelhead sampling at Bonneville Dam, and various fishery monitoring activities (Table 1). Methods of non-Indian fishing include hook-line, drift gillnet, and setline (which target sturgeon exclusively).

The treaty Indian fall season fisheries included in this proposal would occur between August 1, 2004, and December 31, 2004. The treaty Indian fall season fisheries include all mainstem Columbia River fisheries between Bonneville Dam and McNary Dam (commonly known as Zone 6), all mainstem Columbia River fisheries upstream of McNary Dam to Wanapum Dam (commonly known as the Hanford Reach Area), and all fisheries within tributaries above Bonneville Dam except for those in the Snake River basin (Table 1).

Methods of treaty Indian fishing include dipnet, hoopnet, bagnet, hook-line and set gillnet. There is also the potential for sturgeon setline fisheries which target sturgeon exclusively. All of these fishing methods may be employed for ceremonial, subsistence, and commercial harvest. In the past few years, commercial gillnet fishing has occurred from mid-August through early October. In some years, subsistence gillnet fisheries have been authorized by the tribes in October.

The states and tribes propose to manage their fisheries subject to various harvest rate caps for individual Evolutionarily Significant Units (ESUs) or ESU components. In some cases, the parties presume that the fisheries will be managed up to the specified harvest rate limit. In other cases the expected harvest rate will be below the harvest rate cap. For example, Snake River fall chinook are considered one of the limiting stocks, and fisheries are likely to be managed up to the 31.29% harvest rate limit. Alternatively, the states propose to manage their fisheries subject to a 2% harvest rate limit on natural-origin steelhead. However, the expectation is that the chinook limit will be reached before the steelhead limit is reached. The expected harvest rate on A-run steelhead for each of the ESUs is generally less than 2%. In discussing the effects of the action, a distinction is therefore made, where appropriate, between a proposed harvest rate cap and the expected harvest rate resulting from the proposed fishery. The ESU specific harvest rate limits are discussed in more detail in section 3 - Effects of the Action.

1.2 Action Area

For purposes of this biological opinion, the action area encompasses the Columbia River from its mouth upstream to the Wanapum Dam, including its tributaries (with the exception of the Willamette River since no fisheries are proposed for the Willamette under the Agreement). The action area therefore includes portions of the states of Washington, Oregon, and Idaho.

Table 1. Columbia River non-Indian, non-treaty Indian and treaty Indian fisheries proposed for 2004 and considered in this biological opinion.

NON-INDIAN FISHERIES	
Non-Indian Commercial Fisheries	
	Mainstem Commercial Salmon/Sturgeon Fisheries
	Fall Commercial Fishery - Select Areas
	*Smelt Commercial Fishery/Test Fishery**
	*Commercial anchovy and herring bait fishery**
Non-Indian Recreational Fisheries	
	Mainstem Salmon/Steelhead Recreational Fishery
	Warmwater Recreational Fishery
	Columbia River Tributary Recreational Salmon and Steelhead Fisheries
	*Select Area Recreational fisheries**
	*Sturgeon Recreational Fishery**
Non-Indian Test/Assessment Fisheries	
	Sturgeon tagging stock assessment
	*Fall Selective Gear Test Fishery**
	Steelhead Sampling at Bonneville Dam
Non-Treaty Indian Subsistence Fishery	
	Wanapum Tribe Subsistence Fishery
TREATY INDIAN FISHERIES	
Zone 6 Fishery	
Hanford Reach Fishery	
Tributary fisheries	
	Little White Salmon River
	Klickitat River
	*Deschutes River **
	John Day River
	Umatilla River
	Walla Walla River
	Yakima River
	*Snake River Basin **

**No anticipated impacts to ESA-listed salmonids*

2.0 STATUS OF SPECIES UNDER THE ENVIRONMENTAL BASELINE

In order to describe a species' status, it is first necessary to define precisely what "species" means in this context. Traditionally, one thinks of the ESA listing process as pertaining to entire taxonomic species of animals or plants. While this is generally true, the ESA also recognizes that there are times when the listing unit must necessarily be a subset of the species as a whole. In these instances, the ESA allows a "distinct population segment" (DPS) of a species to be listed as threatened or endangered. Snake River fall chinook salmon are just such a DPS and, as such, are for all intents and purposes considered a "species" under the ESA.

NMFS developed the approach for defining salmonid DPSs in 1991 (Waples 1991). It states that a population or group of populations is considered distinct if they are "substantially reproductively isolated from conspecific populations," and if they are considered "an important component of the evolutionary legacy of the species." A distinct population or group of populations is referred to as an evolutionarily significant unit (ESU) of the species. Hence, Snake River fall chinook salmon, for example, constitute an ESU of the species *O. tshawytscha*.

In its review of population status and the effects of the proposed actions on the listed salmonid ESUs in the Columbia River basin, NMFS is using developing science from several areas including the Viable Salmonid Populations (VSP) paper and Recovery Exploitation Rate (RER) analysis. Each of these are described briefly below to provide context prior to their application in the subsequent ESU-specific status discussions.

Viable Salmonid Population

One approach for assessing the status of an ESU and its component populations that is being developed by NMFS is described in a paper related to VSPs (McElhany et. al. 2000). This paper provides guidance for determining the conservation status of populations and ESUs that can be used in ESA-related processes. In this biological opinion, we rely on VSP guidance in describing the population or stock structure of each ESU and the related effects of the action.

A population is defined in the VSP paper as a group of fish of the same species spawning in a particular lake or stream (or portion thereof) at a particular season, which to a substantial degree do not interbreed with fish from any other group spawning in a different place or in the same place at a different season. Because populations as defined here are relatively isolated, it is biologically meaningful to evaluate the risk of extinction of one population independently from any other. Some ESUs may have only one population while others will have many.

The task of identifying populations within an ESU will require making judgments based on the available information. Information regarding the geography, ecology, and genetics of the ESU are relevant to this determination. This is a task that will generally be taken up as part of the recovery planning process. Recovery planning is just now getting underway in the Columbia River Basin. The Willamette/Lower Columbia River Technical Review Team (TRT) has provided preliminary recommendations regarding the historic population structure for the Lower Columbia River chinook, Lower Columbia River steelhead, and Columbia River chum ESUs (Myers et al. 2002). The TRT for the Interior Columbia Basin ESUs has also provided preliminary guidance regarding the population structure of chinook and steelhead ESUs. NMFS also provided interim guidance regarding abundance and productivity targets for Snake River fall chinook, and Snake River, Upper Columbia River, and Middle Columbia River steelhead (Lohn 2002). It is appropriate in this biological opinion to consider the potential diversity of each ESU and the status of the component populations using the available information.

The VSP paper also provides guidance regarding parameters that can be used for evaluating population status including abundance, productivity, spatial structure, and diversity. In this biological opinion we consider particularly the guidance related to abundance. The paper provides several rules of thumb that are intended to serve as guidelines for setting population specific thresholds (McElhany et al. 2000). The guidance relates to defining both "viable" populations levels and "critical" abundance levels. Although there are still no specific recommendations regarding threshold abundance levels for the effected ESUs, the concepts are developed in the biological opinion to the degree possible for evaluating population status and the related effect of the action. NMFS has recently provided interim abundance targets for ESUs in the Interior Columbia Basin (Lohn 2002) and these are considered where appropriate.

Recovery Exploitation Rate

In general and where possible, NMFS has sought to evaluate the proposed fisheries using biologically-based measures of the total exploitation rate that occurred across the full range of the species. Toward this end, NMFS has developed an approach for defining target exploitation rates that can be related directly to the regulatory definition of jeopardy. One product of this approach is a rebuilding exploitation rate (RER) that can be calculated for representative stocks within ESUs. NMFS can then evaluate proposed fisheries, at least in part, by comparing the RERs to stock-specific exploitation rates that are anticipated as a result of the proposed fisheries including those outside the action area. This method has been developed and applied primarily with respect to Puget Sound chinook stocks (NMFS 2000a). However, an RER has been developed and used in recent years for evaluating harvest related mortality for the Coweeman stock in the Lower Columbia River ESU. The RER approach was used as part of the assessment of the Pacific Salmon Treaty in 1999 (NMFS 1999a), the 2000 biological opinion on PFMC fisheries (NMFS 2000a) and more recently for applications of take limits for Puget Sound chinook under the 4(d) Rule (NMFS 2001a, NMFS 2003). NMFS recently updated their RER analysis for the Coweeman stock which is part of the Lower Columbia River chinook ESU, and used the updated RER for evaluating ocean fisheries in 2003 and 2004 (Lohn and McInnis 2004). Because of the comprehensive nature of the Coweeman RER standard and close relationship between ocean and inriver fisheries, the Parties proposed to use it for evaluating inriver fisheries as well.

NMFS recently completed a comprehensive status review for 27 West Coast salmon and steelhead ESUs previously listed as threatened or endangered species under the ESA (July 31, 2003 BRT Report). NOAA Fisheries recently proposed revisions to Columbia Basin salmon and steelhead listing determinations (69 FR 33102, June 14, 2004) based on the status review. There are seven ESUs currently listed as threatened or endangered under the ESA that may be affected by the proposed fall season fisheries. Under the proposed listing rule, the listing status of Upper Columbia River steelhead would change from endangered to threatened. The remaining six ESUs would continue to be listed as threatened. Lower Columbia coho salmon are now proposed for listing as threatened under the ESA. The Federal Register notice also proposes that some of the hatchery-origin fish, that are clearly related to natural-origin fish, should be included as part of the listed ESUs. If the final determination (expected in 2005) reflects this proposal, then those hatchery fish determined to be part of the ESUs will be included as part of the revised ESU definitions.

The discussion to follow will be divided into two parts: Species Life History, Distribution, Trends, and Critical Habitat; and Factors Affecting the Environmental Baseline.

2.1 Life History, Critical Habitat, Distribution and Trends of Affected ESUs

Out of the thirteen salmonid ESUs in the Columbia River listed or proposed for listing under the ESA, eight are present in the action area and may be affected by the proposed fisheries (Table 2). Snake River fall chinook, Lower Columbia River chinook salmon, and Columbia River chum salmon ESUs are listed as threatened. The Upper Columbia River steelhead ESU is listed as endangered; and Snake River, Lower Columbia River, and Middle Columbia River steelhead ESUs are listed as threatened. The Lower Columbia River coho ESU is proposed for listing as threatened.

Critical habitat was previously designated for all of the affected listed ESUs. However, for all affected ESUs, except for Snake River fall chinook, the critical habitat designations were vacated and remanded to NMFS for new rule making pursuant to a May 2002 court order. In absence of a new rule designating critical habitat for those ESUs, this consultation will evaluate the effects of the proposed actions on the essential features of species' habitat to determine whether those actions are likely to jeopardize the species' continued existence. Critical habitat for Lower Columbia River coho has not yet been proposed for designation.

Table 2. Summary of salmonid species from the Columbia River basin listed under the

Endangered Species Act. Evolutionarily Significant Units (ESUs) shown in bold are potentially affected by the proposed action.[1]

Species	Evolutionarily Significant Unit	Present Status	Federal Register Notice	
Chinook Salmon (*O. tshawytscha*)	**Snake River Fall** Snake River Spring/Summer **Lower Columbia River** Upper Willamette River Upper Columbia River Spring	Threatened Threatened Threatened Threatened Endangered	57 FR 14653 57 FR 14653 64 FR 14308 64 FR 14308 64 FR 14308	4/22/92 4/22/92 3/24/99 3/24/99 3/24/99
Chum Salmon (*O. keta*)	**Columbia River**	Threatened	64 FR 14570	3/25/99
Sockeye Salmon (*O. nerka*)	Snake River	Endangered	56 FR 58619	11/20/91
Coho Salmon (*O. kisutch*)	**Lower Columbia River**	Proposed as Threatened	69 FR 33102	6/14/04
Steelhead (*O. mykiss*)	**Upper Columbia River** **Snake River Basin** **Lower Columbia River** Upper Willamette River **Middle Columbia River**	Endangered Threatened Threatened Threatened Threatened	62 FR 43937 62 FR 43937 63 FR 13347 64 FR 14517 64 FR 14517	8/18/97 8/18/97 3/19/98 3/25/99 3/25/99

[1] Non-bolded ESUs are not affected because their run timing is such that they have passed through areas of proposed fisheries prior to the start of fishing on August 1st.

2.1.1 Snake River Fall Chinook Salmon

<u>Life history and critical habitat</u>

Adult fall chinook begin entering the Columbia River in July and August. The Snake River component of the fall chinook run migrates past the Lower Snake river mainstem dams in September and October. Spawning occurs from October through November. Juveniles emerge from the gravels in March and April of the following year. Snake River fall chinook are subyearling migrants, moving downstream from natal spawning and early rearing areas from June through early fall. The ocean distribution of Snake River fall chinook extends from the Gulf of Alaska to central California, although the center of their ocean distribution is located to the north off of Vancouver Island.

Fall chinook returns to the Snake River generally declined through the first half of this century (Irving and Bjornn 1981). In spite of the declines, the Snake River basin remained the largest single natural production area for fall chinook in the Columbia drainage into the early 1960s (Fulton 1968). Spawning and rearing habitat for Snake River fall chinook was reduced by approximately 80% by the construction of a series of dams on the mainstem Snake River. Historically, the primary spawning fall chinook spawning areas were located on the upper mainstem Snake River. Currently, natural spawning is limited to the area from the upper end of Lower Granite Reservoir to Hells Canyon dam and the lower reaches of the Imnaha, Grande Ronde, Clearwater and Tucannon rivers.

Because of the lack of data describing the distribution of fall chinook before development of the hydrosystem, it is not possible to define the historical population structure. However, fish in the

ESU currently tend to aggregate in areas of suitable habitat, with scattered spawning between aggregates. It is likely that a similar population structure extended upstream. The ESU likely historically consisted of a single independent population with discontinuous aggregates functioning as elements of a metapopulation. Regardless of what the historical structure was, Snake River fall chinook are now considered to consist of a single naturally spawning population.

Lyons Ferry Hatchery was established as one of the hatchery programs under the Lower Snake Compensation Plan administered through the USFWS. Snake River fall chinook production is a major program for Lyons Ferry Hatchery, which is operated by the Washington Department of Fish and Wildlife and is located along the Snake mainstem between Little Goose Dam and Lower Monumental Dam. WDFW began developing a Snake River fall chinook broodstock in the early 1970s through a trapping program at Ice Harbor Dam and Lower Granite Dam. The Lyons Ferry facility became operational in the mid-1980s and took over incubation and rearing for the Snake River egg bank program.

The Snake River fall chinook ESU include all natural-origin fall chinook in the mainstem Snake River and several tributaries including the Tucannon, Grande Ronde, Salmon, and Clearwater rivers. Four artificial propagation programs are also considered to be part of the ESU including the Lyons Ferry Hatchery, Fall Chinook Acclimation Ponds Program, Nez Perce Tribal Hatchery, and Oxbow Hatchery fall chinook programs. Critical habitat for the Snake River fall chinook salmon ESU was designated on December 28, 1993 (58 FR 68543).

<u>Distribution and trends</u>

No reliable estimates of historical abundance are available, but because of their dependence on mainstem habitat for spawning, fall chinook have probably been impacted to a greater extent by the development of irrigation and hydroelectric projects than any other species of salmon on the Columbia River. It has been estimated that the mean number of adult Snake River fall chinook salmon declined from 72,000 in the 1930s and 1940s to 29,000 during the 1950s. In spite of this, the Snake River remained the most important natural production area for fall chinook in the entire Columbia River basin through the 1950s. The number of adults counted at the uppermost Snake River mainstem dams averaged 12,720 total spawners from 1964 to 1968, 3,416 spawners from 1969 to 1974, and 610 spawners from 1975 to 1980 (Waples, et al. 1991). The escapement of adult, natural-origin fish continued to decline through the 1980s reaching a low of 78 individuals in 1990 (Table 3, Figure 1) just prior to their listing under the ESA in 1992.

The abundance of Snake River fall chinook increased gradually after 1990 and more significantly in recent years. The recent increase in abundance is due in part to returns from the hatchery supplementation program and in part to higher survival rates. During each of the last three years more than 12,000 adult Snake River fall chinook returned to Lower Granite Dam. Some of these were marked hatchery fish that were removed for use as brood stock. Total escapement past Lower Granite Dam averaged nearly 11,000 from 2001 - 2003. The number of natural-origin fish escaping past Lower Granite Dam averaged over 3,700 (Table 3).

These returns can be compared to the previously identified lower abundance threshold of 300 and the interim recovery escapement goal of 2,500. These are the kinds of benchmarks suggested in the Viable Salmonid Populations paper (McElhany et al. 2000), which NMFS relies on for guidance for evaluating population status. The lower threshold is considered indicative of increased relative risk to a population in the sense that the further and longer a population is below the threshold, the greater the risk; it was clearly not characterized as a "redline" below which a population must not go (BRWG 1994). The interim recovery goal of at least 2,500 naturally produced spawners (to be calculated as an eight year geometric mean) in the lower Snake River and its tributaries was initially identified in the 1995 Proposed Recovery Plan for Snake River Salmon (NMFS 1995). NMFS subsequently reiterated its recommendation of the 2,500 fish as an interim abundance target for Snake River fall chinook (Lohn 2002). The Interior Columbia Basin Technical Recovery Team (TRT) is currently developing delisting criteria for Snake River fall chinook and other listed species, but their recommendations are not yet available.

Figure 1. Escapement of adult Snake River fall chinook past Lower Granite Dam.

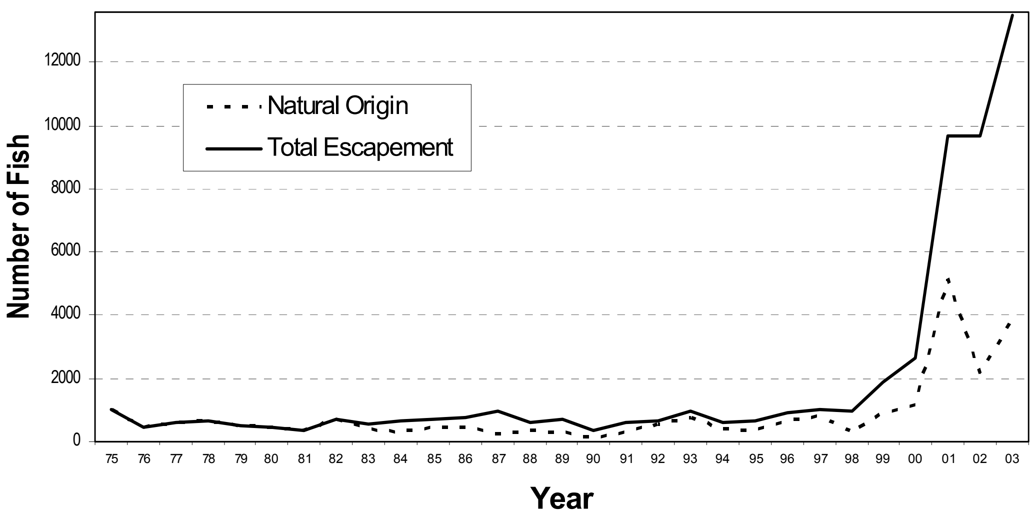


Table 3. Escapement and Stock Composition of Adult Fall Chinook at Lower Granite Dam

Year	Lower Granite Count	Marked Fish to Lyons Ferry Hatch.	Lower Granite Dam Escapement	Stock Comp. of Lower Granite Escapement: Natural Origin	Hatchery Origin: Snake R.	Hatchery Origin: Non-Snake R.
1975	1,000		1,000	1,000		
1976	470		470	470		
1977	600		600	600		
1978	640		640	640		
1979	500		500	500		
1980	450		450	450		
1981	340		340	340		
1982	720		720	720		
1983	540		540	428	112	
1984	640		640	324	310	6
1985	691		691	438	241	12
1986	784		784	449	325	10
1987	951		951	253	644	54
1988	627		627	368	201	58
1989	706		706	295	206	205
1990	385	50	335	78	174	83
1991	630	40	590	318	202	70
1992	855	187	668	549	100	19
1993	1170	218	952	742	43	167
1994	791	185	606	406	20	180
1995	1,067	430	637	350	1	286
1996	1,308	389	919	639	74	206
1997	1,451	444	1,007	797	190	20
1998	1,909	947	962	306	479	177
1999	3,381	1,519	1,862	905	882	75
2000	4,036	1,372	2,664	1,148	1,393	123
2001	12,793	2,918	9,675	5,163	5,070	274
2002	12,297	2,406	9,691	2,116	7,831	166
2003*	13,963	458	13,505	3,856	8,565	1,083

* Preliminary

Increases in the escapement of Snake River fall chinook are due in part to returns from the Lyons Ferry Hatchery release and supplementation program. The Lyons Ferry Hatchery stock is part of the Snake River fall chinook ESU. The Lyons Ferry program was initiated with on-station releases from the 1983 brood year. The Lyons Ferry supplementation program involves outplanting of yearlings and sub-yearlings above Lower Granite Dam, most often from acclimatation sites. The supplementation program was initiated with releases from the 1994 brood year, but has been scaled up in recent years to include approximately 450,000 yearling and 2,000,000 or more sub-yearling releases with further increases in the sub-yearling component of the program anticipated.

The general increase in abundance is also apparent from other indicators. The number of redds observed in the Snake River and associated tributaries reflects the significant increase in escapement seen in recent years (Figure 2). Higher escapements have resulted in an increase in the number of sub-yearling outmigrants arriving at Lower Granite Dam (Figure 3). Jack counts at Lower Granite Dam also provide an early indicator of future returns and they too have been at record levels (Figure 4). The jack counts in 2003 suggest that the returns in 2004 will be generally comparable to those observed in the last three years. The 2004 forecast for natural origin Snake River fall chinook to the river mouth is 6,100 compared to and estimated return in 2003 of 6,900 (JCRMS 2004).

Figure 2. Fall chinook redds in Snake River and tributaries between Lower Granite and Hells Canyon dams.

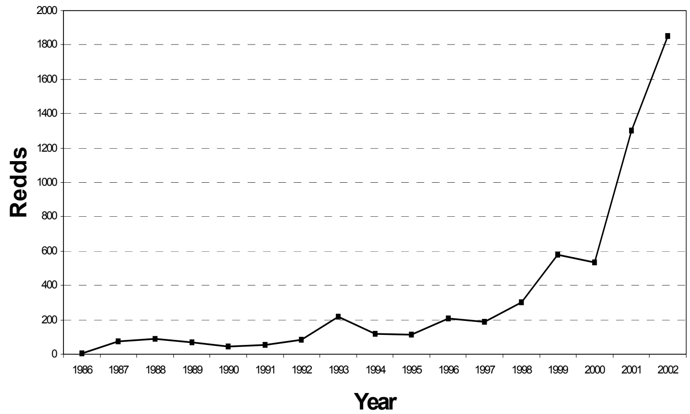


Figure 3. Estimated number of natural-origin sub-yearling outmigrants at Lower Granite Dam.

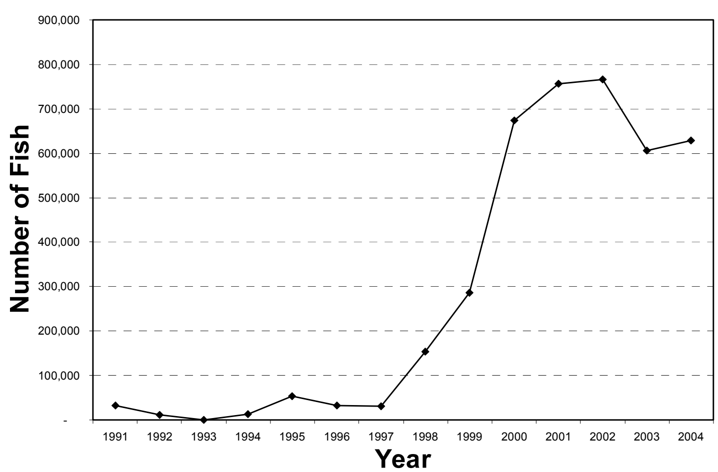


Figure 4. Fall chinook jacks observed at Lower Granite Dam.

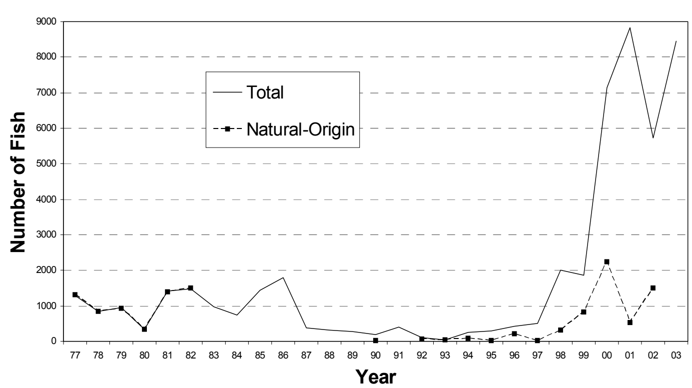
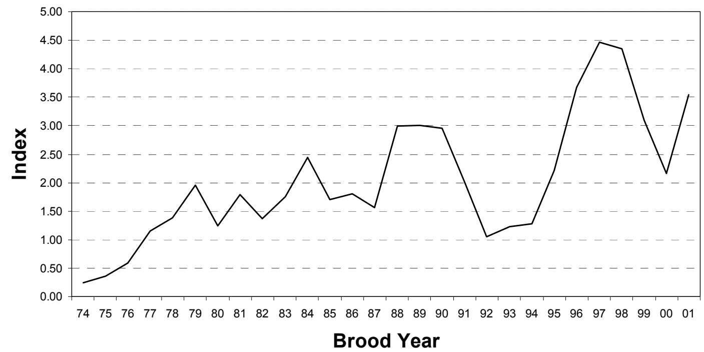


Figure 5. Early life history survival index for Lyons Ferry Hatchery fall chinook.



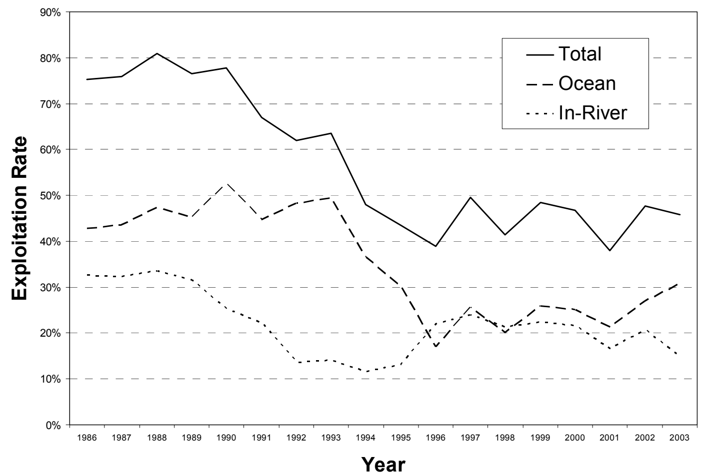
Although the observed increase in abundance is due in part to higher returns from the supplementation program, higher escapements of hatchery and natural-origin fish are also due to improvements in survival. The Pacific Salmon Commission's Chinook Technical Committee calculates a survival index that measures the annual variability in natural mortality before the second year of ocean residence referred to as an environmental variant (EV) scalar (PSC 2003). The survival index for the Lyons Ferry Hatchery stock has been generally increasing and is up substantially in recent years (Figure 5). Increased returns can therefore be attributed to both increases in the supplementation program and improved survival conditions.

The Biological Review Team recently reported on productivity trends based on an analysis of data available through 2001 ((July 31, 2003 BRT Report). The BRT concluded that both the long-term and short-term trends in natural returns are positive (1.013, 1.188). The short-term (1990-2001) estimates of the median population growth rate λ are 0.98 with a hatchery spawning effectiveness of 1.0 (equivalent to that of wild spawners) and 1.137 with a hatchery spawning effectiveness of 0. The estimated long-term growth rate for the Snake River fall chinook population is strongly influenced by the hatchery effectiveness assumption. If hatchery spawners have been equally as effective as natural-origin spawners in contributing to brood year returns, the long-term λ estimate is 0.899 and the associated probability that λ is less than 1.0 is estimated as 98.7%. If hatchery returns over Lower Granite Dam are not contributing at all to natural production, the long-term estimate of λ is 1.024. The associated probability that λ is greater than 1.0 is 25.7%, under the assumption that hatchery effectiveness is 0. Broodyear return-per-spawner (r/s) estimates were low for three or more consecutive years in the mid-1980s and the early 1990s. The large increase in natural abundance in 2000 and 2001 is reflected by increases in the 1996 and 1997 return-per-spawner estimates (1997 r/s based on 4-year-old component only). The BRT analysis did not include the now available data for 2002 and 2003.

In considering the proposed 2004 fisheries, it is also pertinent to review the magnitude of harvest reductions. The average harvest rate of Snake River fall chinook in the Columbia River since 1994 is 20% (LeFleur 2004, Table 3), actually lower than the 31.29% limit that has been in place since that time. Taken from a broader perspective we can look at the combined impact of ocean and inriver fisheries and how that has changed over the last 20 years. The exploitation rate on Snake River fall chinook in the ocean and inriver fisheries combined has declined from an average of 67%, from 1986-1995, to 45%, since 1995, representing a 34% reduction in the overall exploitation rate.

The existence of the Lyons Ferry program is also a consideration in evaluating the status of the ESU since it reduces the short-term risk of extinction by providing a reserve of fish from the ESU. The return of fish from the supplementation program is not a substitute for the return of self-sustaining natural populations. However, supplementation can generally be used to mitigate the short-term risk of extinction by boosting the initial abundance of spawners while other actions are taken to increase the productivity of the system to the point where the population is self-sustaining and supplementation is no longer required. Aggressive supplementation was adopted as part of an interim recovery strategy for Snake River fall chinook because of the circumstances particular to this ESU. As described above, much of the historic habitat for Snake River fall chinook was eliminated with spawning now limited to what were historically marginal areas. Because Snake River fall chinook are mainstem spawners, the opportunity for habitat improvements is relatively limited. Survival rates have increased partly because of actions taken to improve passage conditions through the migration corridor. Supplementation was adopted as part of the mix of strategies to increase abundance, promote species survival, and provide the opportunity for eventual recovery as defined under the ESA.

Figure 6. Ocean and in-river exploitation rates for Snake River fall chinook.



The Lyons Ferry hatchery programs have contributed to the recent substantial increases in total ESU abundance, including both natural-origin and hatchery-origin ESU components. Spawning escapement has increased to several thousand adults (from a few hundred in the early 1990's) due in large part to increased releases from these hatchery programs. These programs collectively have had a beneficial effect on ESU abundance in recent years. The BRT noted, however, that the large but uncertain fraction of naturally spawning hatchery fish complicates assessments of ESU productivity. The contribution of ESU hatchery programs to the productivity of the ESU in-total is uncertain. As ESU abundance has increased in recent years, ESU spatial distribution has increased. The Snake River fall-run chinook hatchery programs contributed to this reduction in risk to ESU spatial distribution. The Lyons Ferry stock has preserved genetic diversity during critically low years of abundance. However, the ESU-wide use of a single hatchery broodstock may pose long-term genetic risks, and may limit adaptation to different habitat areas. Although the ESU likely historically consisted of a single independent population, it was most likely composed of diverse production centers. Additionally, the broodstock collection practices employed pose risks to ESU spatial structure and diversity. Release strategies practiced by the ESU hatchery programs (e.g., extended captivity for about 15 percent of the fish before release) is in conflict with the Snake River fall-run chinook life history, and may compromise ESU diversity. Collectively, artificial propagation programs in the ESU provide slight benefits to ESU abundance, spatial structure, and diversity, but have neutral or uncertain effects on ESU productivity (69 FR 33102, June 14, 2004).

2.1.2 Lower Columbia River Chinook Salmon

Life history and critical habitat

The Lower Columbia River chinook ESU includes spring stocks, and fall tule[1] and bright[2] components. Spring-run chinook salmon on the Lower Columbia River enter freshwater and tributary spawning areas in March and April well in advance of spawning in August and September. The spring component of the Lower Columbia River chinook ESU will not be affected by the proposed fall season fisheries.

Fall chinook predominate the Lower Columbia River salmon ESU. Fall chinook return to the river in mid-August and spawn within a few weeks (WDF and WDW 1993, Kostow 1995). The majority of fall-run chinook salmon emigrate to the marine environment as subyearlings (Reimers and Loeffel 1967, Howell et al. 1985, WDF and WDW 1993). A portion of returning adults whose scales indicate a yearling smolt migration may be the result of extended hatchery-rearing programs rather than of natural, volitional yearling emigration. It is also possible that modifications in the river environment may have altered the duration of freshwater residence. Adults return to tributaries in the Lower Columbia River at 3 and 4 years of age for fall-run fish and 4 to 5 years of age for spring-run fish. This may be related to the predominance of yearling smolts among spring-run stocks. Marine coded-wire-tag recoveries for Lower Columbia River stocks tend to occur off the British Columbia and Washington coasts, though a small proportion of the tags are recovered as far north as Alaska.

As part of its effort to develop viability criteria for Lower Columbia River chinook, The Willamette/Lower Columbia Technical Recovery Team (WLC-TRT) has identified historically demographically independent populations (Myers et al. 2002). Population boundaries are based on an application of Viable Salmonid Populations definition (McElhany et al. 2000). Myers et al. hypothesized that the ESU historically consisted of 20 fall-run populations (“tules”), two late fall-run populations (“brights”) and nine spring-run populations for a total of 31 populations (Myers et al. 2002). As mentioned above, the nine spring-run populations are not affected by the proposed action and therefore are excluded from the analysis in this biological opinion. The WLC-TRT stratified Lower Columbia River Chinook populations based on life-history characteristics and ecological zones (McElhany et al. 2002). The WLC-TRT suggests that a

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[1] “Tules” spawn within a few weeks of river return. They are distinguished by their dark skin coloration and advanced state of maturation at the time of freshwater entry (WDF et al. 1993) and exhibit distinct secondary maturation characteristics (including resorbed scales and pronounced kype). Most tule populations return to production areas lower in the Columbia River drainage.

[2] “Brights” are less mature at freshwater entry than tules, with a longer time interval between freshwater entry and spawning (Marshall et al. 1995). Brights return to areas throughout the basin, but are generally later returning and are primarily destined for areas higher in the drainage. Differences between tules and brights are consistent with genetic analysis (Myers et al. 1998).

viable ESU would need a number of viable populations in each of these strata.

Several of the hatchery populations in the Lower Columbia River are included in the ESU but were not listed. Under the proposed listing, 17 hatchery-origin populations would be included as part of the listed ESU. Critical habitat for the Lower Columbia River chinook ESU was designated on February 16, 2000 (65 FR 7764), but was subsequently vacated by the May 2002 court order (68 FR 55900, September 29, 2003).

Distribution and trends

There are no reliable estimates of historic abundance for this ESU, but it is generally agreed that there have been vast reductions in natural production over the last century. Recent abundance of spawners includes a 5-year average of 28,000 natural spawners (1997-2001) with an additional escapement of 23,300 fish to the hatcheries (PFMC 2002). About two-thirds of the natural spawners were presumably first-generation hatchery strays.

All basins in the region are affected to varying degrees by habitat degradation. Major habitat problems are related primarily to blockages, forest practices, urbanization in the Portland and Vancouver areas, and agriculture in flood plains and low-gradient tributaries. Substantial chinook salmon spawning habitat has been blocked (or passage substantially impaired) in the Cowlitz (Mayfield Dam 1963, RKm 84), Lewis (Merwin Dam 1931, RKm 31), Clackamas (North Fork Dam 1958, RKm 50), Hood (Powerdale Dam 1929, RKm 7), and Sandy (Marmot Dam 1912, RKm 48; Bull Run River dams in the early 1900s) rivers (WDF and WDW 1993, Kostow 1995).

There are three self-sustaining natural populations of tule chinook in the Lower Columbia River (Coweeman, East Fork Lewis, and Sandy) that are not substantially influenced by hatchery strays. These are all relatively small stocks. The average escapement on the Coweeman over the last five and ten years have been about 565 and 775, respectively, compared to an interim escapement goal of 1,000. These averages have been influenced substantially by the record escapements observed in 1996 and 1997 which ranged from 1,300 to 2,100 fish. From 1998 to 2000 escapements averaged about 120, but compare to escapements observed through much of the data record since 1964. The escapements in 2001, 2002, and 2003 were 632, 891, and 1082, respectively, compared to an escapement goal of 1,300. The return of earlier timed tules to the East Fork Lewis has been relatively stable and averaged 333 over the last five years compared to an escapement goal in this relatively small system of 300. The escapements in 2001, 2002, and 2003 were 309, 740, and 354, respectively.

The tule stock in the Clackamas was apparently reestablished after it was largely eliminated from in-basin hatchery production that took place between 1952 and 1981 (Myers et al. 2002). There is some question whether the tule run currently in the Sandy is native or introduced from hatchery production (Myers et al. 2002). There is currently no goal for the Sandy where observed escapements have averaged about 135 and 125, respectively over the last five and ten years. There have been no releases of hatchery fall chinook in the Sandy since 1977 and there are apparently few hatchery strays in this system. There was a fourth population in the

Clackamas that was previously presumed to be lass affected by hatchery strays. The tule stock in the Clackamas was apparently reestablished from in-basin hatchery production that took place between 1952 and 1981 (Meyers st al. 2002) after it was largely eliminated by substantial temperature and pollution problems earlier in the century. However, it was also apparently supported by strays from a large tule production program at Stayton Ponds on the Willamette River (Pers. Comm. K. Melcher, ODFW August 4, 2004). After the closure of the Stayton Ponds in the mid-1990s, natural spawning in the Clackamas declined to very low levels, with zero fish reported in 2003. It is therefore apparent that natural production from hatchery strays was not self sustaining.

There is also some natural spawning of tule fall chinook in the Wind, Little White Salmon, and Hood rivers, tributaries above Bonneville Dam. Although there may be some natural production in these systems, the spawning results primarily from hatchery-origin strays.

The Lower Columbia River bright stocks are one of the few healthy natural chinook stocks in the Columbia River basin. Escapement to the North Fork Lewis River has exceed its escapement goal of 5,700 by a substantial margin every year since 1980 with a recent five year average escapement of 9,871. The escapement in 1999 was about 2,600, substantially below goal for the first time in 20 years or more. The escapements in the four years since have averaged 11,679 and are thus again well above the escapement goal. The low return in 1999 has been attributed to severe flooding that occurred in 1995 and 1996 and was an apparent aberration.

There are two smaller groups of late-spawning Lower Columbia River brights in the Sandy and East Fork Lewis rivers. Myers et al. (2002) recently concluded that the North Fork and East Fork Lewis River bright stocks were likely part of the same demographically independent population (DIP), and that they were closely related genetically to the Sandy River bright DIP. Escapements to the East Fork have averaged only about 277 over the last five years, but have been stable for at least the last ten years. Escapement in the East Fork in 2003 was over 352 adults. Average run sizes in the Sandy have averaged about 850 over the last ten years, and 650 over the last five years. The escapement in 2003 was 619, about the same as that observed in recent years.

Hatchery programs to enhance chinook salmon fisheries in the lower Columbia River began in the 1870s, expanded rapidly, and have continued throughout this century. Although the majority of the stocks have come from within this ESU, over 200 million fish from outside the ESU have been released since 1930. Available evidence indicates a pervasive influence of hatchery fish on natural populations throughout this ESU, including both spring- and fall-run populations (Howell et al. 1985, Marshall et al. 1995). In addition, the exchange of eggs between hatcheries in this ESU has led to the extensive genetic homogenization of hatchery stocks (Utter et al. 1989).

There are seventeen artificial propagation programs releasing hatchery chinook salmon that are considered to be part of the Lower Columbia River chinook ESU (69 FR 33102, June 14, 2004). All of these programs are designed to produce fish for harvest, with three of these programs also being implemented to augment the naturally spawning populations in the basins where the fish are released. These three programs integrate naturally produced spring chinook salmon into the broodstock in an attempt to minimize the genetic effects of returning hatchery adults that spawn naturally.

Hatchery programs have increased total returns and numbers of fish spawning naturally, thus reducing risks to ESU abundance. Although these hatchery programs have been successful at producing substantial numbers of fish, their effect on the productivity of the ESU in-total is uncertain. Additionally, the high level of hatchery production in this ESU poses potential genetic and ecological risks to the ESU, and confounds the monitoring and evaluation of abundance trends and productivity.

The few programs that regularly integrate natural fish into the broodstock may help preserve genetic diversity within the ESU. However, the majority of hatchery programs in the ESU have not converted to the regular incorporation of natural broodstock, thus limiting this risk-reducing feature at the ESU scale. Past and ongoing transfers of broodstock among hatchery programs in different basins represent a risk to within and among population diversity. Collectively, artificial propagation programs in the ESU provide slight benefits to ESU abundance, spatial structure, and diversity, but have neutral or uncertain effects on ESU productivity (69 FR 33102, June 14, 2004).

2.1.3 Columbia River Chum Salmon

<u>Life history and critical habitat</u>

Historically, chum salmon were distributed throughout the coastal regions of western Canada and the United States, as far south as Monterey Bay, California. Presently, major spawning populations are found only as far south as Tillamook Bay on the northern Oregon coast.

Chum salmon (*Oncorhynchus keta*) are semelparous, spawn primarily in freshwater and, apparently, exhibit obligatory anadromy (there are no recorded landlocked or naturalized freshwater populations) (Randall et al. 1987). Chum salmon spend more of their life history in marine waters than other Pacific salmonids. Chum salmon usually spawn in the lower reaches of rivers, with redds usually dug in the mainstem or in side channels of rivers from just above tidal influence to nearly 100 km from the sea. Juveniles outmigrate to seawater almost immediately after emerging from the gravel that covers their redds (Salo 1991). This ocean-type migratory behavior contrasts with the stream-type behavior of some other species in the genus Oncorhynchus (e.g., coastal cutthroat trout, steelhead, coho salmon, and most types of chinook and sockeye salmon), which usually migrate to sea at a larger size, after months or years of freshwater rearing. This means that survival and growth in juvenile chum salmon depend less on freshwater conditions (unlike stream-type salmonids which depend heavily on freshwater habitats) than on favorable estuarine conditions. Another behavioral difference between chum salmon and species that rear extensively in freshwater is that chum salmon form schools, presumably to reduce predation (Pitcher 1986), especially if their movements are synchronized to swamp predators (Miller and Brannon 1982).

The updated information provided by the WLC-TRT suggests that at least 88% of the historical populations are extirpated, or nearly so. The loss of off-channel habitats and the extirpation of approximately 17 historical populations increase the Columbia River chum salmon ESU's vulnerability to environmental variability and catastrophic events. The BRT found high risks for each of the VSP categories, particularly for ESU spatial structure and diversity (69 FR 33134, June 14, 2004).

The Columbia River chum ESU includes all naturally spawned populations of chum salmon in the Columbia River and its tributaries in Washington and Oregon (64 FR 14508; March 25, 1999). Three artificial propagation programs are considered to be part of the ESU: the Chinook River (Sea Resources Hatchery), Grays River, and Washougal River/Duncan Creek chum hatchery programs. NMFS has determined that these artificially propagated stocks are genetically similar to the natural populations and have proposed to include as part of the listed ESU (69 FR 33102, June 14, 2004). Critical habitat for the Columbia River chum ESU was designated on February 16, 2000 (65 FR 7764), but was subsequently vacated by the May 2002 court order (68 FR 55900, September 29, 2003).

Distribution and trends

The Columbia River historically contained large runs of chum salmon that supported a substantial commercial fishery in the first half of this century. These landings represented a harvest of more than 500,000 chum salmon in some years. Currently chum salmon are limited to tributaries below Bonneville Dam, with the majority of fish spawning on the Washington side of the Columbia River, and in several areas of the mainstem Columbia River. Many lower Columbia tributaries once produced chum, however, significant chum natural production is currently limited to just two areas: Grays River near the mouth of the Columbia River, and Hardy and Hamilton creeks that are just downstream of Bonneville Dam. Small numbers of adult chum salmon have been observed in several other lower Columbia River tributaries, as well as several areas in the mainstem Columbia River in the area between the I-205 bridge and Bonneville Dam. A few chum cross Bonneville Dam in some years, but these are likely lost to the system as there are no known spawning areas above Bonneville Dam. Grays River chum salmon enter the Columbia River from mid-October to mid-November, but apparently do not reach the Grays River until late October to early December. These fish spawn from early November to late December. Fish returning to Hamilton and Hardy Creeks begin to appear in the Columbia River earlier than Grays River fish (late September to late October) and have a more protracted spawn timing (mid-November to mid-January).

Of the three primary populations in the Lower Columbia River, Grays River and Hamilton Creek are considered depressed though not critical, while the Hardy Creek population is considered healthy (WDF and WDW 1993) based on long term escapement trends. Hymer (1993, 1994) and WDF and WDW (1993) monitored returns of chum salmon to three streams in the Columbia River and suggested that there may be a few thousand, perhaps up to 10,000, chum salmon spawning annually in the Columbia River basin, although in 2003 it is estimated that between 20,000 - 25,000 chum spawned in the Columbia River basin.

The Grays River is located near the mouth of the Columbia River. Escapement to the Grays

River system has ranged from several hundred to over 5,000 over the last ten years. A hatchery supplementation program was initiated in the Grays River beginning in 1996 using native broodstock to help rebuild the population. Peak chum salmon counts in the Grays River system ranged between 800 and 7,000 and averaged 2,300 from 1996-2001 (WDFW 2001).

Hamilton Creek is located 3.0 miles below Bonneville Dam. There is only about 1 mile of spawning habitat in Hamilton Creek and its tributaries. Escapements have averaged less than 100 fish in recent years, until 2001 when the peak count was over 900 fish. The WDFW recently completed a major restoration effort on Spring Channel which is a spring fed tributary to Hamilton Creek that supports chum spawning. Peak chum salmon counts ranged between 5 and 925 and averaged 180 from 1996-2001 (WDFW 2001).

Hardy Creek is located just downstream of Hamilton Creek. Chum spawn in the lower 1.5 miles of the stream. Annual escapements over the last 10 years have ranged from 22 to 1,153 spawners, but are generally increasing. Hardy Creek is now incorporated into the Pierce National Wildlife Refuge and has benefitted from recent habitat improvement programs as well. Peak chum salmon counts ranged between 20 and 443 and averaged 193 from 1996-2001 (WDFW 2001).

Although current abundance is only a small fraction of historical levels, and much of the original inter-populational diversity has presumably been lost, the total spawning run of chum salmon to the Columbia River has been relatively stable since the mid 1950s, and total natural escapement for the ESU is probably at least several thousand fish per year. In 2003, the spawning population in this ESU is estimated at 20,000 -25,000 fish. Whether this large increase is due to any recent management actions or simply reflects unusually good conditions in the marine environment is not known at this time, but the result is encouraging, particularly if it were to be sustained for a number of years.

There are three artificial propagation programs producing chum salmon considered to be part of the Columbia River chum ESU. These are conservation programs designed to support natural production. The Washougal Hatchery artificial propagation program provides artificially propagated chum salmon for re-introduction into recently restored habitat in Duncan Creek, Washington. This program also provides a safety-net for the naturally spawning population in the mainstem Columbia River below Bonneville Dam, which can access only a portion of spawning habitat during low flow conditions. The other two programs are designed to augment natural production in the Grays River and the Chinook River in Washington. All these programs use naturally produced adults for broodstock. These programs were only recently established (1998-2002), with the first hatchery chum returning in 2002.

2.1.4 Lower Columbia River Coho

<u>Life history and critical habitat</u>

The Lower Columbia River coho ESU includes all naturally spawned populations of coho salmon in the Columbia River and its tributaries from the mouth of the Columbia up to and including the Big White Salmon and Hood Rivers. Twenty-one artificial propagation programs are considered to be part of the ESU): the Grays River, Sea Resources Hatchery, Peterson Coho Project, Big Creek Hatchery, Astoria High School (STEP) Coho Program, Warrenton High School (STEP) Coho Program, Elochoman Type-S Coho Program, Elochoman Type-N Coho Program, Cathlamet High School FFA Type-N Coho Program, Cowlitz Type-N Coho Program in the Upper and Lower Cowlitz Rivers, Cowlitz Game and Anglers Coho Program, Friends of the Cowlitz Coho Program, North Fork Toutle River Hatchery, Lewis River Type-N Coho Program, Lewis River Type-S Coho Program, Fish First Wild Coho Program, Fish First Type-N Coho Program, Syverson Project Type-N Coho Program, Sandy Hatchery, and the Bonneville/Cascade/Oxbow complex coho hatchery programs. NMFS has determined that these artificially propagated stocks are genetically no more than moderately divergent from the natural populations (NMFS, 2004a).

Four additional populations are considered extirpated. The populations were grouped into three ecological zones as has been done for other ESUs including the Coastal, Cascade, and Gorge zones. There are only two populations in the Lower Columbia River coho ESU with appreciable natural production located in the Sandy and Clackamas rivers. During the 1980s and 1990s, natural spawners were not observed in the lower tributaries in the ESU. Coincident with the abundance increases in the Sandy and Clackamas populations observed since 2000, a small number of coho spawners of unknown origin has been surveyed in some lower tributaries. Approximately 40 percent of historical habitat is currently inaccessible, which restricts the number of areas that might support natural production in the future.

The Lower Columbia River coho ESU included populations with both early and late return timing. Early timed coho enter the Columbia River starting in mid-August and are in the tributaries and spawning by mid-October. Late timed coho enter the Columbia River in late September and spawn from November to February or even as late as March. The ocean migration of early timed coho is generally to the south of the Columbia River, while late timed fish are north migrating. The Sandy River has an early timed population. The Clackamas River apparently has both early and late timed populations although there is still some contention about whether the populations are distinct. Zhou and Chilcote (2004) concluded that the early stock was derived from a brief hatchery introduction effort in the 1960's. Coho returning to the Clackamas now have two peaks of return timing. There are DNA differences between the timing groups, and well as timing and spatial separation among the spawners. The two groups also appear to have different productivity characteristics. On the other hand there were only two late spawners identified in 1999 with a resulting adult return in 2002 of 183 which seems inconsistent with the idea that the early and late timed groups are really distinct and isolated. Nonetheless, the weight of evidence at this time supports the hypothesis that early and late timed populations are distinct with the late component representing the native stock. Critical Habitat for Lower Columbia coho salmon has not been designated.

<u>Distribution and trends</u>
The Sandy and Clackamas Rivers contain the only two populations in the ESU with significant natural production. Adult escapements to the Sandy and Clackamas are enumerated through dam counts (Table 4). Recent escapements can be compared to estimates of a full seeding

escapement goal of 1,340 for the Sandy River. The ODFW currently uses a composite full seeding escapement goal of 3,800 for the Clackamas composite population for management purposes. However, Zhou and Chilcote (2004) conducted a more recent spawner recruit analysis of the early and late timed populations in the Clackamas. Escapement goals corresponding to maximum sustained yield and maximum sustained production for the early timed population were estimated to be 1,200 and 1,500, respectively. Estimates for the late timed population were far less certain. Parameter estimation is hampered by the lack of escapements beyond the range of those observed to date. With these reservations, Zhou and Chilcote recommended using 3,800 and 6,300 as tentative escapement goals associated with maximum sustained yield and maximum sustained production for management purposes pending collection of more data and further review.

The extreme loss of naturally spawning populations, the low abundance of extant populations, diminished diversity, and fragmentation and isolation of the remaining naturally produced fish confer considerable risks on the ESU. The paucity of naturally produced spawners in this ESU is contrasted by the very large number of hatchery produced adults. The abundance of hatchery coho returning to the Lower Columbia River from 2001 to 2003 ranged from 600,000 to more than one million. The BRT expressed concern that the magnitude of hatchery production continues to pose significant genetic and ecological threats to the extant natural populations in the ESU. However, these hatchery stocks collectively represent a significant portion of the ESU's remaining genetic resources. The 21 hatchery stocks considered to be part of the ESU, if managed appropriately, may prove essential to the restoration of more widespread naturally spawning populations (69 FR 33102, June 14, 2004).

All of the 21 hatchery programs included in the Lower Columbia River coho ESU are designed to produce fish for harvest, with two small programs also designed to augment the natural spawning populations in the Lewis River basin. Past artificial propagation efforts imported out-of-ESU fish for broodstock, generally did not mark hatchery fish, mixed broodstocks derived from different local populations, and transplanted stocks among basins throughout the ESU. The result is that the hatchery stocks considered to be part of the ESU represent a homogenization of populations. Several of these risks have recently begun to be addressed by improvements in hatchery practices. Out-of-ESU broodstock is no longer used, and near 100-percent marking of hatchery fish is employed to afford improved monitoring and evaluation of broodstock and (hatchery- and natural-origin) returns. However, many of the within-ESU hatchery programs do not adhere to best hatchery practices. Eggs are often transferred among basins in an effort to meet individual program goals, further compromising ESU spatial structure and diversity.

Table 4. Dam Counts of Adult Coho Salmon at Marmot Dam in the Sandy River, and the North Fork Dam in the Clackamas River.

Return	Marmot Dam	North Fork Dam Coho Adults		
Year	Adult Coho	Early	Late	Total

1978	411	57	1,076	1,133
1979	680	157	1,053	1,210
1980	632	63	833	896
1981	620	316	467	783
1982	722	730	414	1,144
1983	na	182	3,010	3,192
1984	798	598	572	1,170
1985	1,445	1,547	1,006	2,553
1986	1,546	77	1,522	1,599
1987	1,205	329	354	683
1988	1,506	2,308	1,007	3,315
1989	2,182	1,108	3,268	4,376
1990	376	635	767	1,402
1991	1,491	978	733	1,711
1992	790	1,062	1,216	2,278
1993	193	423	302	725
1994	601	2,201	922	3,123
1995	697	1,556	1,920	3,476
1996	180	118	50	168
1997	116	2,099	784	2,883
1998	261	976	1,061	2,037
1999	162	86	2	88
2000	730	1,251	184	1,435
2001	1,340	255	114	369
2002	310	695	183	878
2003	1,173	1,734	368	2,102

Programs may use broodstock that does not reflect what was historically present in a given basin, limiting the potential for artificial propagation to establish locally adapted naturally spawning populations.

As discussed above, the majority of the ESU's genetic diversity exists in the hatchery programs. Although these programs have the potential of preserving historical local adaptation and behavioral and ecological diversity, the manner in which these potential genetic resources are presently being managed poses significant risks to the diversity of the ESU in-total. At present, the Lower Columbia River coho hatchery programs reduce risks to ESU abundance and spatial structure, provide uncertain benefits to ESU productivity, and pose risks to ESU diversity. Overall, artificial propagation mitigates the immediacy of ESU extinction risk in the short-term but is of uncertain contribution in the long term (69 FR 33102, June 14, 2004).

2.1.5 Upper Columbia Steelhead

<u>Life history and critical habitat</u>

The life-history patterns of upper Columbia steelhead are complex. Adults return to the

Columbia River in the late summer and early fall; most migrate relatively quickly up the mainstem to their natal tributaries. A portion of the returning run overwinters in the mainstem reservoirs, passing over the upper mid-Columbia dams in April and May of the following year. Spawning occurs in the late spring of the calendar year following entry into the river. Juvenile steelhead spend 1 to 7 years rearing in freshwater before migrating to the ocean. Smolt outmigrations are predominately age 2 and age 3 juveniles. Most adult steelhead return after 1 or 2 years at sea, starting the cycle again. Although the life history of this ESU is similar to that of other inland steelhead, smolt ages are some of the oldest in the West Coast (up to 7 years old), probably due to ubiquitous cold water temperatures (Mullan et al. 1992). Adults spawn later than most downstream populations, remaining in freshwater up to a year before spawning.

An initial set of population definitions for Upper Columbia steelhead ESU along with basic criteria for evaluating the status of each population were developed using the Viable Salmonid Population (VSP) guidelines described in McElhany et al. (2000). The definitions and criteria are described in Ford et al. (2000) and have been used in the development and review of Mid-Columbia PUD plans and the FCRPS Biological Opinion. The interim definitions and criteria are being reviewed as recommendations by the Interior Columbia Technical Recovery Team. Briefly, the joint technical team recommended that the Wenatchee River, the Entiat River and the Methow River be considered as separate populations within the Upper Columbia Steelhead ESU. The Okanogan River may have supported a fourth population, the committee deferred a decision on the Okanogan to the Technical Recovery Team (BRT 2003). Critical habitat for the Upper Columbia River steelhead ESU was designated on August 18, 1997 (62 FR 43937), but was subsequently vacated by the May 2002 court order (68 FR 55900, September 29, 2003).

Distribution and trends

Upper Columbia River steelhead inhabit the Columbia River reach and its tributaries upstream of the Yakima River. This region includes several rivers that drain the east slopes of the Cascade Mountains and several that originate in Canada (only U.S. populations are included in the ESU). Dry habitat conditions in this area are less conducive to steelhead survival than in many other parts of the Columbia basin (Mullan et al. 1992).

Estimates of the annual returns of upper Columbia steelhead populations are based on dam counts. Cycle counts are used to accommodate the prevalent return pattern in up-river summer steelhead (runs enter the Columbia in late summer and fall, some fish overwinter in mainstem reservoirs—migrating past the upper dams prior to spawning the following spring).

Returns of both hatchery and naturally produced steelhead to the upper Columbia River have increased in recent years (Table 5). Priest Rapids Dam is below Upper Columbia River steelhead ESU production areas and therefore is used as an indicator for returns to the ESU as a whole. The average 1999-2003 return to Priest Rapids Dam is approximately 16,700 steelhead. The average for the previous five years (1994-1998) was 6,900 fish. The total returns of upper Columbia River continue to be predominately hatchery-origin fish. The natural-origin percentage of the run over Priest Rapids increased to over 25% in the 1980s, then dropped to less than 10% in the mid-1990s. The average percent of natural-origin fish for 1999-2003 was 18%. The natural component of the annual steelhead run over Priest Rapids increased from an average of 880 (1994-1998) to 3,050 (1999-2003) compared to an interim abundance target of 5,500 (Lohn 2002).

More specific estimates of escapement to individual production areas is based on subsequent dam counts. The estimate of the combined natural steelhead return to the Wenatchee and Entiat rivers increased from 500 during 1994-1998 to 1,800 during the last five years. This compares to an interim abundance target of 3,000 (Lohn 2002).

The Methow River is the primary production area above Wells Dam with relatively little production in the Okanogan. The number of natural-origin fish returning to the Methow and Okanogan has increased from 170 during 1994-1998 to 660 during the last five years. This compares to an interim abundance target of 2,500 (Lohn 2002). The return of hatchery fish has also increase substantially in recent years with a recent five year average of 8,300.

Natural returns have increased in recent years, but the productivity of these populations is less clear. Population growth is substantially influenced by assumptions regarding the relative effectiveness of hatchery spawners. Two sets of assumptions were used in estimating λ and generating return-per-spawner series for upper Columbia steelhead data sets. These assumptions represented the extremes in the range of possible outcomes relative hatchery effectiveness values. Relative hatchery effectiveness is assumed to equal 1 or 0 with respect to fish of natural origin. Under the assumption that hatchery effectiveness is 0, naturally produced fish returning in a year are the progeny of the natural returns one brood cycle earlier. Under the assumption that hatchery effectiveness is 1.0, natural steelhead returning in any given year are assumed to be the product of total (hatchery plus natural) spawners.

Table 5. Run year returns of adult summer steelhead to Priest Rapids Dam, and to the Wenatchee/Entiat and Methow/Okanogan systems.

	Priest Rapids		Wenatchee/Entiat		Methow/Okanogan	
Year	Total (LeFleur 2004)	Natural-Origin (LeFleur 2004)	Total	Natural-Origin	Total	Natural-Origin
1974	2,950					
1975	2,560					
1976	9,490					
1977	9,630					
1978	4,510					
1979	8,710					
1980	8,290					
1981	9,110					

1982	10,770					
1983	32,000					
1984	26,200					
1985	34,010					
1986	22,364	2,342	5,925	1,464	13,234	503
1987	14,013	4,058	5,072	2,510	5,195	871
1988	10,200	2,670	3,236	1,663	4,415	573
1989	10,718	2,685	2,748	1,556	4,608	576
1990	7,837	1,585	1,678	953	3,819	340
1991	13,968	2,799	2,551	1,612	7,715	601
1992	13,720	1,618	4,153	1,050	7,073	347
1993	5,428	890	1,517	510	2,400	191
1994	6,735	855	2,806	454	2,183	202
1995	4,370	993	2,321	709	945	116
1996	8,600	843	1,515	351	4,127	260
1997	8,942	785	962	495	4,107	111
1998	5,847	928	564	488	2,668	182
1999	8,277	1,374	1,546	515	3,557	402
2000	11,364	2,341	2,243	1,497	6,280	521
2001	30,077	5,715	6,575	4,391	18,146	853
2002	15,867	2,983	3,425	2,063	9,475	682
2003	17,727	2,836	3,897	1,224	7,505	863

Both short-term and long-term estimates of λ are positive under the assumption that hatchery fish have not contributed to natural production in recent years. λ estimates under the assumption that hatchery fish contributed at the same level as wild fish to natural production are substantially lower—under this scenario natural production is consistently and substantially below the total number (hatchery plus natural origin) of spawners in any given year.

Return-per-spawner patterns for the two steelhead production areas are also substantially influenced by assumptions regarding the relative effectiveness of hatchery origin spawners. Under the assumption that hatchery and wild spawners are both contributing to the subsequent generation of natural returns, return-per-spawner levels have been consistently below 1.0 since 1976. Under this scenario natural production would be expected to decline rapidly in the absence of hatchery spawners. Under the assumption that hatchery fish returning to the upper Columbia do not contribute to natural production, return-per-spawner levels were above one until the late 1980s. Return-per-spawner estimates subsequently dropped below replacement (1.0) and remained low until the most recent brood years (BRT 2003).

The actual contribution of hatchery returns to natural spawning remains a key uncertainty for upper Columbia steelhead. This information need is in addition to any considerations for long-term genetic impacts of high hatchery contributions to natural spawning.

Because of concerns related to the low abundance of some of the populations and apparent shortfalls in system productivity, NMFS has authorized several steelhead supplementation programs in the upper Columbia River basin. Efforts are underway to diversify broodstocks used for supplementation in an effort to minimize the differences between hatchery and natural-origin fish and to minimize the concerns associated with supplementation. NMFS expects that the supplementation program will benefit the listed fish due to the early life history survival advantage expected from the hatchery action. However, there are also substantive concerns about the long term effect on the fitness of natural-origin populations resulting from continuous long term infusion of hatchery-influenced spawners (Busby et al. 1996). In summary, the hatchery component of the Upper Columbia River listed steelhead is abundant. The natural component was quite depressed through most of the decade of the 90's, but has rebounded in recent years. It is hoped that supplementation efforts can be used to moderate potential future declines in abundance until the necessary, long-term improvements in system productivity take effect.

2.1.6 Snake River Steelhead

<u>Life history and critical habitat</u>

Resident *O. mykiss* are believed to be present in many of the drainages utilized by Snake River steelhead. Very little is known about interactions between co-occurring resident and anadromous forms within this ESU. The following review of abundance and trend information focuses on information directly related to the anadromous form.

The Snake River steelhead ESU is distributed throughout the Snake River drainage system, including tributaries in southwest Washington, eastern Oregon and north/central Idaho (NMFS, 1996a). Snake River steelhead migrate a substantial distance from the ocean (up to 1,500 km) and use high elevation tributaries (typically 1,000-2,000 m above sea level) for spawning and juvenile rearing. Snake River steelhead occupy habitat that is considerably warmer and drier (on an annual basis) than other steelhead ESUs. Snake River basin steelhead are generally classified as summer run, based on their adult run timing patterns. Summer steelhead enter the Columbia River from late June to October. After holding over the winter, summer steelhead spawn during the following spring (March to May). Managers classify up-river summer steelhead runs into to groups based primarily on ocean age and adult size upon return to the Columbia River. A-run steelhead are predominately age-1 ocean fish while B-run steelhead are larger, predominated by age-2 ocean fish.

B-run steelhead are distinguished from the A-run component by their unique life history characteristics. B-run steelhead were traditionally distinguished as larger and older, later-timed fish that return primarily to the South Fork Salmon, Middle Fork Salmon, Selway, and Lochsa rivers. The recent review by the TAC concluded that different populations of steelhead do have different size structures with populations dominated by larger fish (>77.5 cm) occurring in the traditionally defined B-run basins (TAC 1999). Larger fish occur in other populations throughout the basin, but at much lower rates. (Evidence suggests that fish returning to the Middle Fork Salmon and Little Salmon are intermediate in that they have a more equal distribution of large and small fish.)

B-run steelhead are also generally older. A-run steelhead are predominately age-1-ocean fish while most B-run steelhead generally spend two or more years in the ocean prior to spawning. The differences in ocean age are primarily responsible for the differences in the size of A and B-run steelhead. However, B-run steelhead are also thought to be larger at age than A-run fish. This may be due, at least in part, to the fact that B-run steelhead leave the ocean later in the year than A-run steelhead and thus have an extra month or more of ocean residence at a time when growth rates are generally at their greatest.

Historically there was a distinctly bimodal pattern of freshwater entry that was used to distinguish A-run and B-run fish. A-run steelhead were presumed to cross Bonneville Dam from June to late August while B-run steelhead enter from late August to October. The TAC also reviewed the available information on timing and confirmed that the majority of large fish still have a later timing as counted at Bonneville with 70% of the larger fish crossing the dam after August 26, the traditional date method cutoff for separating A and B-run fish. The timing of earlier A-run fish has shifted somewhat later thereby reducing the timing separation that was so apparent in the 60's and 70's. However, the TAC concluded that the timing of the larger, natural-origin B-run fish is unchanged (TAC 1999).

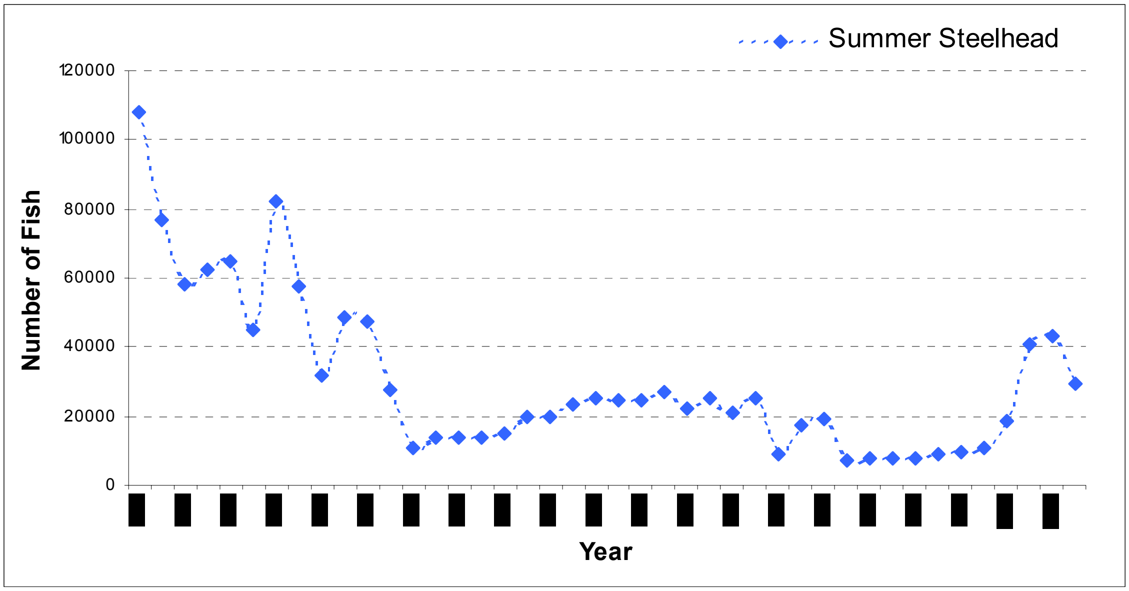
As pointed out above, the geographic distribution of B-run steelhead is restricted to particular watersheds within the Snake River basin (areas of the mainstem Clearwater, Selway and Lochsa Rivers, South and Middle Forks of the Salmon River). Although recent genetic data are not yet available for steelhead populations in the Salmon River, the Dworshak North Fork Hatchery (NFH) stock and natural populations in the Selway and Lochsa Rivers are the most genetically distinct populations of steelhead in the Snake River basin (NMFS, unpublished). In addition, the Selway and Lochsa River populations from the Middle Fork Clearwater appear to be very similar to each other genetically, and naturally produced rainbow trout from the North Fork Clearwater River (above Dworshak Reservoir) clearly show an ancestral genetic similarity to Dworshak NFH steelhead. The existing genetic data, the restricted geographic distribution of B-run steelhead in the Snake River basin, and the unique life history attributes of these fish (i.e. larger, older adults with a later distribution of run timing compared to A-run steelhead in other portions of the Columbia River basin) clearly support the discrimination of B-run steelhead as a biologically significant and distinct component of the Snake River ESU.

With one exception (the Tucannon River production area), the tributary habitat used by Snake River steelhead ESU is above Lower Granite Dam. Major groupings of populations and/or subpopulations can be found in 1) the Grande Ronde River system; 2) the Imnaha River drainage; 3) the Clearwater River drainages; 4) the South Fork Salmon River; 5) the smaller mainstem tributaries before the confluence of the mainstem; 6) the Middle Fork salmon production areas, 7) the Lemhi and Pahsimeroi valley production areas and 8) upper Salmon River tributaries. The Interior Columbia Basin TRT tentatively identified 24 populations in this ESU, eight of which are in the B-run production areas. Fish from six hatchery production programs are considered part of hte ESU and are proposed to be included in the revised listing of the ESU (69 FR 33102, June 14, 2004). Critical habitat for the Snake River steelhead ESU was designated on August 18, 1997 (62 FR 43937), but was subsequently vacated by the May 2002 court order (68 FR 55900, September 29, 2003).

<u>Distribution and trends</u>
Although direct historical estimates of production from the Snake basin are not available, the basin is believed to have supported more than half of the total steelhead production from the Columbia basin (Mallet 1974). There are some historical estimates of returns to portions of the drainage. Lewiston Dam, constructed on the lower Clearwater, began operation in 1927. Counts of steelhead passing through the adult fish ladder at the dam reached 40-60,000 in the early 1960s (Cichosz et al. 2001). Based on relative drainage areas, the Salmon River basin likely supported substantial production as well. In the early 1960s, returns to the Grande Ronde River and the Imnaha River may have exceeded 15,000 and 4,000 steelhead per year, respectively (ODFW 1991). Extrapolations from tag/recapture data indicate that the natural steelhead return to the Tucannon River may have exceeded 3,000 adults in the mid-1950s (WDF 1992).

The longest consistent indicator of Snake Basin steelhead abundance is based on counts of natural-origin steelhead at the uppermost dam on the lower Snake River. Abundance of natural-origin summer steelhead at the uppermost dam on the Snake River has declined generally until quite recently (Figure 7). The general pattern has included a sharp decline in abundance in the early 1970's, modest rebuilding from the mid-1970's through the 1980's, and second period of decline during the much of decade of the 1990's. For the last four years the LGD counts have been substantially higher with counts of wild steelhead of 20,580, 47,716, 57,291, and 45,391 (Table 6). The counts over the last three years are the highest observed since the early 70's.

Figure 7. Adult Returns of Natural-origin Steelhead to the Uppermost Dam on the Snake River



The available data allows us to distinguish the abundance of the A-run and B-run components of Snake Basin steelhead only since 1985. Both components declined through the 90's, but the decline for B-run steelhead has been the most significant. The 4-year average count of natural-origin A-run steelhead at LGD was 17,700 beginning in 1985 compared to a recent average of 25,900, although there was an extended period of decline in between (Table 6). The comparative four year averages for natural-origin B-run steelhead were 6,100 and 7,200 (Table 6). Although the count of B-run steelhead reached a record low of just 890 fish in 1999, counts over the last four years have ranged from 3,200 to a recent record high in 2002 of 14,200 fish.

Comparison of recent dam counts with escapement objectives provides perspective regarding the status of the ESU. The management objective from the CRFMP for Snake River steelhead was to return 30,000 natural/wild steelhead to LGD. The All Species Review (ASR)(TAC 1997) further clarifies that this objective is subdivided into 20,000 A-run and 10,000 B-run steelhead to LGD. There is also a table in the ASR that further divides the escapement goals by sub-basin (e.g., 8,000 B-run steelhead to the Clearwater River and 2,000 to the Salmon River)(Table 7).

Table 6. Lower Granite Dam Counts of Summer Steelhead

	Group A			Group B			Total		
	Hatchery	Wild	Total	Hatchery	Wild	Total	Hatchery	Wild	Total
1985		17,850			8,858		89,626	26,708	116,334

1986	72,095	16,727	88,822	35,897	5,264	41,161	107,992	21,991	129,983
1987	32,133	20,093	52,226	13,677	5,377	19,054	45,810	25,470	71,280
1988	44,132	16,327	60,459	21,920	4,758	26,678	66,052	21,085	87,137
1989	66,553	16,952	83,505	39,899	8,016	47,915	106,452	24,968	131,420
1990	25,561	4,803	30,364	22,018	4,483	26,501	47,579	9,286	56,865
1991	69,850	14,141	83,991	11,881	3,180	15,061	81,731	17,321	99,052
1992	83,353	13,574	96,927	25,566	5,772	31,338	108,919	19,346	128,265
1993	35,510	5,914	41,424	16,904	1,440	18,344	52,414	7,354	59,768
1994	32,411	5,071	37,483	7,375	2,444	9,819	39,786	7,516	47,302
1995	63,562	6,701	70,263	7,573	1,290	8,863	71,135	7,991	79,126
1996	67,066	5,979	73,045	12,209	1,644	13,853	79,275	7,623	86,898
1997	66,981	7,411	74,392	10,898	1,327	12,225	77,879	8,738	86,617
1998	45,246	7,305	52,551	17,986	2,371	20,357	63,231	9,677	72,908
1999	53,478	9,966	63,444	8,748	890	9,639	62,227	10,856	73,083
2000	67,438	14,859	82,298	15,956	4,010	19,966	83,394	18,870	102,264
2001	197,587	37,855	235,442	30,670	3,169	33,839	228,257	41,024	269,281
2002	125,090	28,902	153,992	53,745	14,198	67,943	178,835	43,101	221,936
2003	118,108	21,873	139,981	25,168	7,259	32,427	143,277	29,132	172,409

Idaho reevaluated these escapement objectives using estimates of juvenile production capacity. This alternative methodology leads to estimates of 22,000 for A-run and 32,700 for B-run steelhead (IDFG 1992). Idaho's analysis did not include escapement goal estimates for A-run steelhead returning to the Imnaha or Grand Ronde rivers. Escapement goals for these rivers were calculated here for comparison using the same methods and assumptions as were used by Idaho Department of Fish and Game (IDFG).

The four lower Columbia River tribes provided yet another set of goals for Snake River steelhead in their Tribal Restoration Plan (TRP) - Wy-Kan-Ush-Me-Wa-Kish-Wit Spirit of the Salmon (CRITFC 1995). The tribes' goals are incomplete in that they do not specify escapement objectives for either A-run or B-run steelhead in the Salmon River. The tribal goals are nonetheless generally higher than the 10,000/20,000 goals contained in the CRFMP.

NMFS recently provided interim abundance targets for Snake River steelhead (Lohn 2002). Although NMFS did not specifically associate these tributary-specific targets with A and B-run designations, they can be sub-divided based on assumptions about where run types predominate. NMFS' interim targets sum to 52,000 including 22,900 A-run and 29,100 B-run steelhead (Tucannon and Asotin targets were not included to be more comparable to the other estimates) (Table 7).

Table 7. Alternative Escapement Goals For Snake River Steelhead (TAC 2002).

Sub-basin	**Stock**	**TAC ASR**	**IDFG**	**TRP**	**NMFS**
Clearwater	B	8,000	16,931	12,000	17,700
Salmon	B	2,000	15,224	[a]	11,400
B-run subtotal	B	**10,000**	**32,155**	**12,000**	**29,100**
Clearwater	A	-	2,150	1,000	[c]
Salmon	A	10,000	20,010	[a]	10,200
Grand Ronde	A	8,000	*7,600*[b]	18,450	10,000
Imnaha	A	2,000	*3,100*[b]	2,100	2,700
A-run subtotal	A	**20,000**	**32,860**	**22,000**	**22,900**
Total		**30,000**	**65,015**	**34,000**	**52,000**

[a] The TRP does not identify escapement goals for A or B-run steelhead in the Salmon River.

[b] Escapement goals for the Grand Ronde and Imnaha were derived from smolt estimates using the same assumptions and methods used by IDFG for Idaho subbasins.

[c] A small but unspecified proportion of the production in the Clearwater is presumably A-run fish (Lohn 2002).

Finally, the TAC recently completed a review of escapement estimates for Snake River steelhead (TAC 2002). The TAC concluded that escapements associated with maximum sustained production measured at LGD were likely within the range of 50,000-70,000. Escapements associated with maximum sustained yield were in the range of 25,000-55,000. These ranges can be divided equally between A and B-run steelhead. The report notes that there remains significant uncertainty related to these estimates, and that additional escapements in the range of 40,000-80,000 or more would help better define the production dynamics of the system.

Idaho has conducted surveys for juvenile abundance in index areas throughout the Snake River basin since 1985 (Figure 8). Parr densities of A-run steelhead (refers to the intermediate juvenile life stage) have declined from an about 82% of carrying capacity in 1985 to an average of about 42% in the last five years (1999-2003). Parr densities of B-run steelhead have been low, but relatively stable since 1985. The average B-run parr densities between 1985 and 1998 was 15%, and between 1999-2003 was 20%. Parr densities in A-run tributaries were generally lower from 1991 through 1999, but increased in 2000 and in 2002 and 2003.

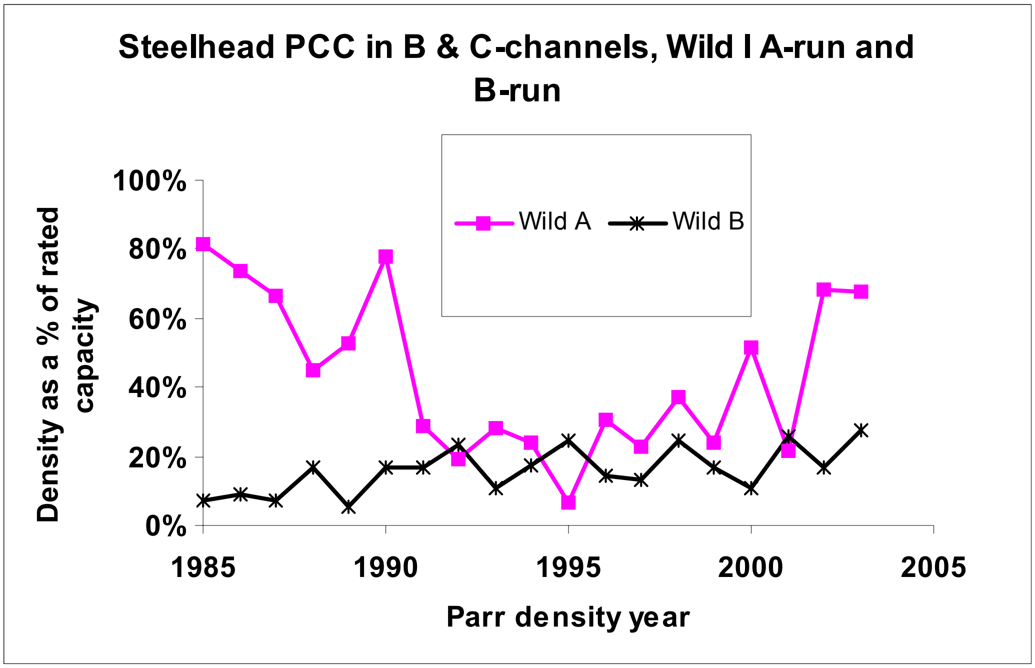


Figure 8. Percent Juvenile Carrying Capacity for A and B-run Steelhead

It is apparent from the available data that B-run steelhead are much more depressed than the A-run component. In evaluating the status of the Snake Basin steelhead ESU it is pertinent to consider whether B-run steelhead represent a "significant portion" of the ESU.
It is first relevant to put the Snake Basin into context. The Snake Basin historically supported over 55% of total natural-origin production of steelhead in the Columbia Basin and now has approximately 63% of the Columbia Basin's natural production potential for natural-origin steelhead (Mealy 1997). B-run steelhead include eight of the 24 populations in the ESU and occupy four major subbasins including two on the Clearwater (Lochsa and Selway) and two on the Salmon River (Middle Fork and South Fork Salmon). Some natural production of B-run steelhead also occurs in parts of the mainstem Clearwater and its major tributaries. As discussed above, there are alternative escapement objectives for B-run steelhead of 10,000 (CRFMP) and 32,700 (Idaho). NMFS' interim abundance targets for B-run steelhead production areas sum to 29,100. B-run steelhead therefore represent at least one third and as much as 55% of the production capacity of the ESU and, for consultation purposes, are considered significant portion of the ESU.

It is apparent from the adult and juvenile abundance data that A and B-run steelhead have been depressed relative to their respective escapement goal. Both have increased in abundance in recent years, but of the two, B-run steelhead is still depressed relative to its escapement goal and relative to the apparent recent recovery of A-run steelehad.

As discussed above, B-run steelhead are the more depressed component of the ESU. However, opportunities to use hatchery supplementation for recovery purposes are limited. There is one B-run hatchery stock in the Snake Basin located at the Dworshak NFH. The Dworshak stock was developed from natural-origin steelhead from within the North Fork Clearwater, is largely free of introductions from other areas, and was included as part of the ESU although not part of the listed population. However, past hatchery practices and possibly changes in flow and temperature conditions related to Dworshak Dam have led to substantial divergence in spawn timing compared to what was observed historically in the North Fork Clearwater, and to natural-origin populations in other parts of the Clearwater Basin. The spawn timing of hatchery stocks is much earlier than it was historically (Figure 9) and this may limit the success of supplementation efforts. Past supplementation efforts in the South Fork Clearwater River using this stock have been largely unsuccessful, although better outplanting practices may yield different results. In addition, the unique genetic character of Dworshak Hatchery steelhead noted above may limit the degree to which the stock can be used for supplementation in other parts of the Clearwater and particularly in the Salmon River B-run basins. Supplementation efforts in those areas, if undertaken, will more likely have to rely on the development of local broodstocks which do not exist at this time. Supplementation opportunities in many of the B-run production areas will be limited in any case because of logistical difficulties in getting to and working in these high mountain, wilderness areas. Opportunities to accelerate the recovery of B-run steelhead through supplementation even if successful are therefore limited. Maximizing escapement of natural-origin steelhead in the near term is therefore essential.

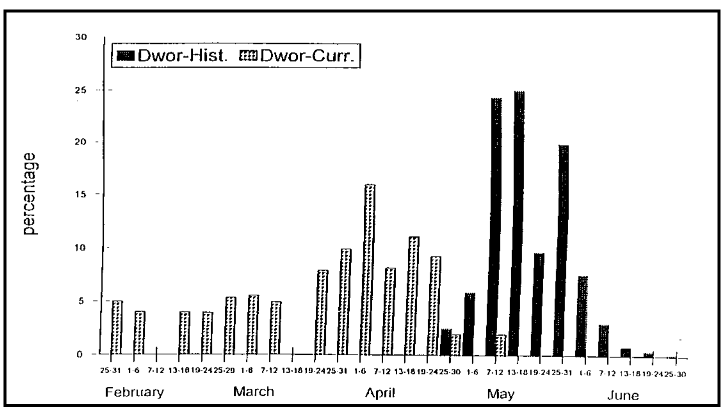


Figure 9. Historic and Current run timing for Hatchery Stocks

2.1.7 Middle Columbia River Steelhead

<u>Life history and critical habitat</u>

The Middle Columbia River Steelhead ESU includes steelhead populations in Oregon and Washington drainages upstream of the Hood and Wind river systems to and including the

Yakima River. The Snake River is not included in this ESU. Major drainages in this ESU are the Deschutes, John Day, Umatilla, Walla-Walla, Yakima, and Klickitat river systems. Almost all steelhead populations within this ESU are summer-run fish, the exceptions being winter-run components returning to the Klickitat, and Fifteen Mile Creek watersheds.

Life history information for steelhead of this ESU indicates that most Middle Columbia River steelhead smolt at 2 years and spend 1 to 2 years in salt water (i.e., 1-ocean and 2-ocean fish, respectively) prior to re-entering fresh water, where they may remain up to a year prior to spawning (Howell et al. 1985). Within this ESU, the Klickitat River is unusual in that it produces both summer and winter steelhead, and the summer steelhead are dominated by 2-ocean steelhead, whereas most other rivers in this region produce about equal numbers of both 1- and 2-ocean steelhead.

The ESU is in the intermontane region and includes some of the driest areas of the Pacific Northwest, generally receiving less than 40 cm of rainfall annually (Jackson 1993). Vegetation is of the shrub-steppe province, reflecting the dry climate and harsh temperature extremes. Because of this habitat, occupied by the ESU, factors contributing to the decline include agricultural practices, especially grazing, and water diversions/withdrawals. In addition, hydropower development has impacted the ESU through loss of habitat above hydro projects, and mortalities associated with migration through the Columbia River hydro system.

Blockages have prevented access to sizable steelhead production areas in the Deschutes River and the White Salmon River. In the Deschutes River, Pelton Dam blocks access to upstream habitat historically used by steelhead. Conduit Dam, constructed in 1913, blocked access to all but 2-3 miles of habitat suitable for steelhead production in the Big White Salmon River. Substantial populations of resident trout exist in both areas.

Hatchery facilities are located in a number of drainages within the geographic area of this ESU, although there are also subbasins with little or no direct hatchery influence. The John Day River system is a large river basin supporting an estimated five steelhead populations. The basin has not been outplanted with hatchery steelhead and out-of-basin straying is believed to be low. The Yakima River system includes four to five populations. Hatchery production in the basin was relatively limited historically and has been phased out since the early 1990s. The Umatilla, the Walla-Walla, and the Deschutes river systems each have ongoing hatchery production programs based on locally derived broodstocks. Straying from out-of-basin production programs into the Deschutes River has been identified as a chronic occurrence. Fish from seven hatchery programs are considered to be part of this ESU and are proposed to be included in the revised ESU listing (69 FR 33102, June 14, 2004). Critical habitat for the Middle Columbia River steelhead ESU was designated on March 15, 1999 (57 FR 14517), but was subsequently vacated by the May 2002 court order (68 FR 55900, September 29, 2003).

<u>Distribution and trends</u>

The abundance of natural populations in the Middle Columbia River *O. mykiss* ESU has increased substantially over the past 5 years. The Deschutes and Upper John Day Rivers have recent 5-year mean abundance levels in excess of their respective interim recovery target abundance levels (Lohn 2002). Due to an uncertain proportion of out-of-ESU strays in the Deschutes River, the recent increases in this population are difficult to interpret. The Umatilla River recent 5-year mean natural population abundance is approximately 72 percent of its interim recovery target abundance level. The natural populations in the Yakima River, Klickitat River, Touchet River, Walla Walla River, and Fifteenmile Creek, however, remain well below their interim recovery target abundance levels. Long-term trends for 11 of the 12 production areas in the ESU were negative, although it was observed that these downward trends are driven, at least in part, by a peak in returns in the middle to late 1980s, followed by relatively low escapement levels in the early 1990s. Short-term trends in the 12 production areas were mostly positive from 1990 to 2001. The continued low number of natural returns to the Yakima River (10 percent of the interim recovery target abundance level, historically a major production center for the ESU) generated concern among the BRT. However, anadromous and resident *O. mykiss* remain well distributed in the majority of subbasins in the Middle Columbia River ESU. The presence of substantial numbers of out-of-basin (and largely out-of-ESU) natural spawners in the Deschutes River, raised substantial concern regarding the genetic integrity and productivity of the native Deschutes population. The extent to which this straying is an historical natural phenomenon is unknown. The cool Deschutes River temperatures may attract fish migrating in the comparatively warmer Columbia River waters, thus inducing high stray rates.

The BRT noted the particular difficulty in evaluating the contribution of resident fish to ESU-level extinction risk. Several sources indicate that resident fish are very common in the ESU and may greatly outnumber anadromous fish. The BRT concluded that the relatively abundant and widely distributed resident fish in the ESU reduce risks to overall ESU abundance, but provide an uncertain contribution to ESU productivity, spatial structure, and diversity (BRT 2003b; 2004a).

ESU hatchery programs may provide a slight benefit to ESU abundance. Artificial propagation increases total ESU abundance, principally in the Umatilla and Deschutes Rivers. The kelt reconditioning efforts in the Yakima River do not augment natural abundance, but do benefit the survival of the natural populations. The Touchet River hatchery program has only recently been established, and its contribution to ESU viability is uncertain. The contribution of ESU hatchery programs to the productivity of the three target populations, and the ESU in-total, is uncertain. The hatchery programs affect a small proportion of the ESU, providing a negligible contribution to ESU spatial structure. Overall the impacts to ESU diversity are neutral. The Umatilla River program, through the incorporation of natural broodstock, likely limits adverse effects to population diversity. The Deschutes River hatchery program may be decreasing population diversity. The recently initiated Touchet River endemic program is attempting to reduce adverse effects to diversity through the elimination of out-of-ESU Lyons Ferry Hatchery steelhead stock. Collectively, artificial propagation programs in the ESU provide a slight beneficial effect to ESU abundance, but have neutral or uncertain effects on ESU productivity, spatial structure, and diversity.

2.1.8 Lower Columbia River Steelhead

Life history and critical habitat

The Lower Columbia River ESU includes naturally-produced steelhead returning to Columbia River tributaries on the Washington side between the Cowlitz and Wind rivers in Washington and on the Oregon side between the Willamette and Hood rivers, inclusive. In the Willamette River, the upstream boundary of this ESU is at Willamette Falls. This ESU includes both winter and summer steelhead. Fish from 10 hatchery programs are considered to be part of the ESU and are proposed to be included in the revised ESU listing (68 FR 33102, June 14, 2004)

As part of its effort to develop viability criteria for Lower Columbia River steelhead, The Willamette/Lower Columbia Technical Recovery Team (WLC-TRT) has identified historically demographically independent populations (Myers et al. 2002). Population boundaries are based on an application of Viable Salmonid Populations definition (McElhany et al. 2000). Myers et al. (2002) hypothesized that the ESU historically consisted of 17 winter-run populations and six summer-run populations for a total of 23 populations. Because of the timing circumstances, winter steelhead populations are not affected by the proposed fisheries.

The WLC-TRT partitioned Lower Columbia River steelhead populations into a number of "strata" based on major life-history characteristics and ecological zones (McElhany et al. 2002). Analysis suggests that a viable ESU would need a number of viable populations in each of these strata. Critical habitat for the Lower Columbia River steelhead ESU was designated on March 19, 1998 (63 FR 13347), but was subsequently vacated by the May 2002 court order (68 FR 55900, September 29, 2003).

Distribution and trends

Some anadromous populations in the Lower Columbia River *O. mykiss* ESU, particularly summer-run steelhead populations, have shown encouraging increases in abundance in the last 2 to 3 years. However, population abundance levels remain small (no population has a recent 5-year mean abundance greater than 750 spawners). The BRT could not conclusively identify a single population that is naturally viable. A number of populations have a substantial fraction of hatchery-origin spawners, and are hypothesized to be sustained largely by hatchery production. Long-term trends in spawner abundance are negative for seven of nine populations for which there are sufficient data, and short-term trends are negative for five of seven populations. It is estimated that four historical populations have been extirpated or nearly extirpated, and only one-half of 23 historical populations currently exhibit appreciable natural production. Although approximately 35 percent of historical habitat has been lost in this ESU due to the construction of dams or other impassible barriers, the ESU exhibits a broad spatial distribution in a variety of watersheds and habitat types. The BRT was particularly concerned about the impact on ESU diversity of the high proportion of hatchery-origin spawners in the ESU, the disproportionate declines in the summer steelhead life history, and the release of non-native hatchery summer steelhead in the Cowlitz, Toutle, Sandy, Lewis, Elochoman, Kalama, Wind, and Clackamas Rivers. Resident fish are not as abundant in this ESU as they are in the inland *O. mykiss* ESUs. The BRT did not consider resident fish to reduce risks to ESU abundance, and their contribution to ESU productivity, spatial structure, and diversity is uncertain (BRT 2003; 2004a).

There are 10 artificial propagation programs releasing hatchery steelhead that are considered to be part of the Lower Columbia River *O. mykiss* ESU. The hatchery programs have reduced risks to ESU abundance by increasing total ESU abundance and the abundance of fish spawning naturally in the ESU. The contribution of ESU hatchery programs to the productivity of the ESU in-total is uncertain. It is also uncertain if reintroduced steelhead into the Upper Cowlitz River will be viable in the foreseeable future, as outmigrant survival appears to be quite low. As noted by the BRT, out-of-ESU hatchery programs have negatively impacted ESU productivity. The within-ESU hatchery programs provide a slight decrease in risks to ESU spatial structure, principally through the re-introduction of steelhead into the Upper Cowlitz River Basin. The eventual success of these reintroduction efforts, however, is uncertain. Harvest augmentation programs that have instituted locally-adapted natural broodstock protocols (e.g., the Sandy, Clackamas, Kalama, and Hood River programs) have reduced adverse genetic effects and benefited ESU diversity. Non-ESU hatchery programs in the Lower Columbia River remain a threat to ESU diversity. Collectively, artificial propagation programs in the ESU provide a slight beneficial effect to ESU abundance, spatial structure, and diversity, but uncertain effects to ESU productivity.

2.2 Factors affecting the Environmental Baseline

Environmental baselines for biological opinions are defined by regulation at 50 CFR 402.02, which states that an environmental baseline is the physical result of all past and present state, Federal, and private activities in the action area along with the anticipated impacts of all proposed Federal projects in the action area (that have already undergone formal or early section 7 consultation). The environmental baseline for this biological opinion is therefore the result of the impacts a great many activities (summarized below) have had on the listed ESUs' survival and recovery. Put another way, the baseline is the culmination of the effects that multiple activities have had on the species' *biological requirements* and, by examining those individual effects, it is possible to describe the species' status in the action area.

Many of the biological requirements for listed ESUs in the action area can best be expressed in terms of essential habitat features. That is, the ESU requires adequate: (1) substrate (especially spawning gravel), (2) water quality, (3) water quantity, (4) water temperature, (5) water velocity, (6) cover/shelter, (7) food, (8) riparian vegetation, (9) space, and (10) migration conditions (February 16, 2000, 65 FR 7764). The best scientific information presently available demonstrates that a multitude of factors, past and present, have contributed to the decline of west coast salmonids by adversely affecting these essential habitat features. NMFS reviewed much of that information in its recently reinitiated Consultation on Operation of the Federal Columbia

River Power System (FCRPS) (NMFS 2000b). That review is summarized in the sections below.

2.2.1 The Mainstem Hydropower System

Hydropower development on the Columbia River has dramatically affected anadromous salmonids in the basin. Storage dams have eliminated spawning and rearing habitat and altered the natural hydrograph of the Snake and Columbia Rivers – decreasing spring and summer flows and increasing fall and winter flows. Power operations cause flow levels and river elevations to fluctuate – slowing fish movement through reservoirs, altering riparian ecology, and stranding fish in shallow areas. The 13 dams in the Snake and Columbia River migration corridors kill smolts and adults and alter their migrations. The dams have also converted the once-swift river into a series of slow-moving reservoirs – slowing the smolts' journey to the ocean and creating habitat for predators. Because most of the affected ESUs must navigate past major hydroelectric projects during their up- and downstream migrations (and experience the effects of other dam operations occurring upstream from their ESU boundary), they are subject to all the impacts described above. For more information on the effects of the mainstem hydropower system, please see NMFS (2000b).

2.2.2 Human-Induced Habitat Degradation

The quality and quantity of freshwater habitat in much of the Columbia River Basin has declined dramatically in the last 150 years. Forestry, farming, grazing, road construction, hydrosystem development, mining, and other development have radically changed habitat conditions in the basin. Water quality in streams throughout the Columbia River Basin has been degraded by human activities such as dams and diversion structures, water withdrawals, farming and animal grazing, road construction, timber harvest activities, mining activities, and development. Over 2,500 streams, river segments, and lakes in the Northwest do not meet Federally-approved, state and tribal water quality standards and are now listed as water quality limited under section 303(d) of the Clean Water Act. Tributary water quality problems contribute to poor water quality when sediment and contaminants from the tributaries settle in mainstem reaches and the estuary.

Most of the water bodies in Oregon, Washington, and Idaho on the 303(d) list do not meet water quality standards for temperature. High water temperatures adversely affect salmonid metabolism, growth rate, and disease resistance, as well as the timing of adult migrations, fry emergence, and smoltification. Many factors can cause high stream temperatures, but they are primarily related to land-use practices rather than point-source discharges. Some common actions that cause high stream temperatures are the removal of trees or shrubs that directly shade streams, water withdrawals for irrigation or other purposes, and warm irrigation return flows. Loss of wetlands and increases in groundwater withdrawals contribute to lower base-stream flows which, in turn, contribute to temperature increases. Activities that create shallower streams (e.g., channel widening) also cause temperature increases.

Pollutants also degrade water quality. Salmon require clean gravel for successful spawning, egg incubation, and the emergence of fry. Fine sediments clog the spaces between gravel and restrict the flow of oxygen-rich water to the incubating eggs. Excess nutrients, low levels of dissolved oxygen, heavy metals, and changes in pH also directly affect the water quality for salmon and steelhead.

Water quantity problems are also an important cause of habitat degradation and reduced fish production. Millions of acres of land in the basin are irrigated. Although some of the water withdrawn from streams eventually returns as agricultural runoff or groundwater recharge, crops consume a large proportion of it. Withdrawals affect seasonal flow patterns by removing water from streams in the summer (mostly May through September) and restoring it to surface streams and groundwater in ways that are difficult to measure. Withdrawing water for irrigation, human consumption, and other uses increases temperatures, smolt travel time, and sedimentation. Return water from irrigated fields introduces nutrients and pesticides into streams and rivers. Water withdrawals (primarily for irrigation) have lowered summer flows in nearly every stream in the basin and thereby profoundly decreased the quantity and quality of habitat.

Blockages that stop downstream and upstream fish movement exist at many dams and barriers, whether they are for agricultural, hydropower, municipal/industrial, or flood control purposes. Culverts that are not designed for fish passage also block upstream migration. Migrating fish are often killed when they are diverted into unscreened or inadequately screened water conveyances or turbines. While many fish-passage improvements have been made in recent years, manmade structures continue to block migrations or kill fish throughout the basin.

On the landscape scale, human activities have affected the timing and amount of peak water runoff from rain and snowmelt. Forest and range management practices have changed vegetation types and density which, in turn, affect runoff timing and duration. Many riparian areas, flood plains, and wetlands that once stored water during periods of high runoff have been destroyed by development that paves over or compacts soil – thus increasing runoff and altering its natural pattern.

Land ownership has also played its part in the region's habitat and land-use changes. Federal lands, which compose 50 percent of the basin, are generally forested and influence upstream portions of the watersheds. While there is substantial habitat degradation across all ownerships, in general, habitat in many headwater stream sections is in better condition than in the largely non-Federal lower portions of tributaries (Doppelt et al. 1993; Frissell 1993; Henjum et al. 1994; Quigley and Arbelbide 1997). In the past, valley bottoms were among the most productive fish habitats in the basin (Stanford and Ward 1992; Spence et al. 1996; ISG 1996). Today, agricultural and urban land development and water withdrawals have substantially altered the habitat for fish and wildlife. Streams in these areas typically have high water temperatures, sedimentation problems, low flows, simplified stream channels, and reduced riparian vegetation.

At the same time Snake River spring/summer chinook salmon habitat was being destroyed by water withdrawals, water impoundments in other areas dramatically reduced Snake River spring/summer chinook salmon habitat by inundating large amounts of spawning and rearing habitat and reducing migration corridors, for the most part, to a single channel. Floodplains have been reduced in size, off-channel habitat features have been lost or disconnected from the main channel, and the amount of large woody debris (large snags/log structures) in rivers has been reduced. Most of the remaining habitats are affected by flow fluctuations associated with reservoir management.

The Columbia River estuary (through which all the basin's species – including Snake River spring/summer chinook salmon – must pass) has also been changed by human activities. Historically, the downstream half of the estuary was a dynamic environment with multiple channels, extensive wetlands, sandbars, and shallow areas. The mouth of the Columbia River was about four miles wide. Winter and spring floods, low flows in late summer, large woody debris floating downstream, and a shallow bar at the mouth of the Columbia River kept the environment dynamic. Today, navigation channels have been dredged, deepened, and maintained; jetties and pile-dike fields have been constructed to stabilize and concentrate flow in navigation channels; marsh and riparian habitats have been filled and diked; and causeways have been constructed across waterways. These actions have decreased the width of the mouth of the Columbia River to two miles and increased the depth of the Columbia River channel at the bar from less than 20 to more than 55 feet. Sand deposition at river mouths has extended the Oregon coastline approximately four miles seaward and the Washington coastline approximately two miles seaward (Thomas 1981).

More than 50 percent of the original marshes and spruce swamps in the estuary have been converted to industrial, transportation, recreational, agricultural, or urban uses. More than 3,000 acres of intertidal marsh and spruce swamps have been converted to other uses since 1948 (Lower Columbia River Estuary Program 1999). Many wetlands along the shore in the upper reaches of the estuary have been converted to industrial and agricultural lands after levees and dikes were constructed. Furthermore, water storage and release patterns from reservoirs upstream of the estuary have changed the seasonal pattern and volume of discharge. The peaks of spring/summer floods have been reduced, and the amount of water discharged during winter has increased.

Human-caused habitat alterations have also increased the number of predators feeding on UCR spring chinook salmon and steelhead. For example, researchers estimated that a population of terns on Rice Island (created under the Columbia River Channel Operation and Maintenance Program) consumed six to 25 million out-migrating salmonid smolts during 1997 (Roby et al. 1998) and seven to 15 million out-migrating smolts during 1998 (Collis et al. 1999). Even after considerable efforts by Federal and state agencies, between 5 and 7 million smolts were consumed in 2001. As another example, populations of Northern pikeminnow (a salmonid predator) in the Columbia River has skyrocketed since the advent of the mainstem dams and their warm, slow-moving reservoirs.

To counteract all the ill effects listed in this section, Federal, state, tribal, and private entities have – singly and in partnership – begun recovery efforts to help slow and, eventually, reverse the decline of salmon and steelhead populations. Nevertheless, while these efforts represent a number of good beginnings, it must be stated that much remains to be done to recover Snake River spring/summer chinook salmon. Full discussions of these efforts can be found in the FCRPS biological opinion (NMFS 2000b).

2.2.3 Hatcheries

For more than 100 years, hatcheries in the Pacific northwest have been used to (a) produce fish for harvest and (b) replace natural production lost to dam construction and other development – not to protect and rebuild naturally produced salmonid populations. As a result, most salmonids returning to the region are primarily derived from hatchery fish. In 1987, for example, 95 percent of the coho salmon, 70 percent of the spring chinook salmon, 80 percent of the summer chinook salmon, 50 percent of the fall chinook salmon, and 70 percent of the steelhead returning to the Columbia River Basin originated in hatcheries (CBFWA 1990). Because hatcheries have traditionally focused on providing fish for harvest, it is only recently that the substantial adverse effects of hatcheries on natural populations been demonstrated. For example, the production of hatchery fish, among other factors, has contributed to the 90 percent reduction in natural coho salmon runs in the lower Columbia River over the past 30 years (Flagg et al. 1995).

NMFS has identified four primary ways hatcheries harm wild-run salmon and steelhead: (1) ecological effects, (2) genetic effects, (3) overharvest effects, and (4) masking effects (NMFS 2000b). Ecologically, hatchery fish can predate on, displace, and compete with natural fish. These effects are most likely to occur when fish are released in poor condition and do not migrate to marine waters, but rather remain in the streams for extended rearing periods. Hatchery fish also may transmit hatchery-borne diseases, and hatcheries themselves may release disease-carrying effluent into streams. Hatchery fish can affect the genetic variability of native fish by interbreeding with them. Interbreeding can also result from the introduction of stocks from other areas. Interbred fish are less adapted to the local habitats where the original native stock evolved and may therefore be less productive there.

In many areas, hatchery fish provide increased fishing opportunities. However, when natural fish mix with hatchery stock in these areas, naturally produced fish can be overharvested. Moreover, when migrating adult hatchery and natural fish mix on the spawning grounds, the health of the natural runs and the habitat's ability to support them can be overestimated because the hatchery fish mask the surveyors' ability to discern actual natural run status.

Currently, the role hatcheries play in the Columbia Basin is being redefined under the Basinwide Salmon Recovery Strategy (Federal Caucus 2000) from simple production to supporting species recovery. These efforts will focus on maintaining species diversity and supporting weak stocks. The program will also have an associated research element designed to clarify interactions between natural and hatchery fish and quantify the effects artificial propagation has on natural fish. The final facet of the strategy is to use hatcheries to create fishing opportunities that are benign to listed populations (e.g., terminal area fisheries). For more detail on the use of hatcheries in recovery strategies, please see the Basinwide Salmon Recovery Strategy.

2.2.4 Harvest

Salmon and steelhead have been harvested in the Columbia basin as long as there have been people there. For thousands of years, native Americans have fished on salmon and other species in the mainstem and tributaries of the Columbia River for ceremonial and subsistence use and for barter. Salmon were possibly the most important single component of the native American diet, and were eaten fresh, smoked, or dried (Craig and Hacker 1940). A wide variety of gears and methods were used, including hoop and dip nets at cascades such as Celilo and Willamette Falls, to spears, weirs, and traps (usually in smaller streams and headwater areas).

Commercial fishing developed rapidly with the arrival of European settlers and the advent of canning technologies in the late 1800s. The development of non-Indian fisheries began in about 1830; by 1861, commercial fishing was an important economic activity. The early commercial fisheries used gill nets, seines hauled from shore, traps, and fish wheels. Later, purse seines and trolling (using hook and line) fisheries developed. Recreational fishing began in the late 1800s, occurring primarily in tributary locations (ODFW and WDFW 2000).

Initially, the non-Indian fisheries targeted spring and summer chinook salmon, and these runs dominated the commercial harvest during the 1800s. Eventually the combined ocean and freshwater harvest rates for Columbia River spring and summer chinook salmon exceeded 80 percent and sometimes 90 percent of the run – accelerating the species' decline. From 1938 to 1955, the average harvest rate dropped to about 60 percent of the total spring chinook salmon run and appeared to have a minimal effect on subsequent returns (NMFS 1991). Until the spring of 2000 – when a relatively large run of hatchery spring chinook salmon returned and provided a small commercial Tribal fishery – no commercial season for spring chinook salmon had taken place since 1977. Present Columbia River harvest rates are very low compared with those from the late 1930s through the 1960s (NMFS 1991).

Salmonids' capacity to produce more adults than are needed for spawning offers the potential for sustainable harvest of naturally produced (versus hatchery-produced) fish. This potential can be realized only if two basic management requirements are met: (1) enough adults return to spawn and perpetuate the run, and (2) the productive capacity of the habitat is maintained. Catches may fluctuate in response to such variables as ocean productivity cycles, periods of drought, and natural disturbance events, but as long as the two management requirements are met, fishing can be sustained indefinitely. Unfortunately, both prerequisites for sustainable harvest have been violated routinely in the past. The lack of coordinated management across jurisdictions, combined with competitive economic pressures to increase catches or to sustain them in periods of lower production, resulted in harvests that were too high and escapements that were too low. At the same time, habitat has been increasingly degraded, reducing the capacity of the salmon stocks to produce numbers in excess of their spawning escapement requirements.

In recent years harvest management has undergone significant reforms and many of the past problems have been addressed. Principles of weak stock management are now the prevailing paradigm. As a result, mixed stock fisheries are managed based on the needs of natural-origin stocks. Managers also account, where possible, for total harvest mortality across all fisheries. The focus is now correctly on conservation and secondarily on providing harvest opportunity where possible directed at harvestable hatchery and natural-origin stocks.

2.2.4.1 Ocean Harvest

<u>Snake River Fall Chinook</u>

Although consultation related to PFMC salmon fisheries and those that occur in Southeast Alaska and Canada are considered in separate biological opinions, ocean fisheries in general have all been subject in recent years to the same ocean exploitation rate limit for Snake River fall chinook. The combined ocean fisheries are required to achieve a 30% reduction in the average 1988-93 base period exploitation rate on Snake River fall chinook (Lohn and McInnis 2004).

In recent years, there have been substantial reductions in ocean fisheries in general, and in Canadian fisheries in particular. As a result, the exploitation rate reduction for combined ocean fisheries has met and exceeded the prescribed standard for Snake River fall chinook. The base period reduction in combined ocean fisheries has averaged 54% since 1996. The expected base period reduction for the combined 2004 ocean fisheries is 67% (PFMC 2003). The 1996-2003 average annual total adult equivalent exploitation rate for Snake River fall chinook (ocean and inriver fisheries combined) is 45% (Table 9).

<u>Lower Columbia River Chinook</u>

The Lower Columbia River chinook ESU includes spring, tule, and bright components. The spring component of the Lower Columbia River ESU will not be affected by the fall season fisheries being considered as part of this proposed action. The average total exploitation rate (ocean and river combined) for tule chinook for 1980-1995 was 64% compared to a 1996-2003 average of 39% (Table 8). The expected exploitation rate on tule stocks in 2004 is 35.9% for all ocean fisheries combined and 43.9% overall including the inriver fisheries. The total exploitation rate for 2004 will thus be below the 49% exploitation rate limit specified by NMFS (Lohn and McInnis 2004). The ocean exploitation rate on Lower Columbia River bright stocks is generally lower. The average total exploitation rate for bright chinook for 1980-1995 was 52% compared to a 1996-2003 average of 31% (Table 9). The expected natural-origin spawning escapement of the North Fork Lewis indicator stock in 2004 is 14,100 compared to an escapement goal of 5,700.

<u>Steelhead</u>

Steelhead are rarely caught in ocean fisheries and therefore ocean harvest is not considered a significant source of mortality to any of the listed steelhead ESUs considered in this biological opinion (Lohn and McInnis 2004).

Table 9. Annual total adult equivalent exploitation rates (ocean and inriver fisheries combined) for selected Columbia River fall chinook stocks and inriver treaty Indian harvest rates for Snake River A and B-run steelhead.

Return Year	Snake River Fall Chinook	Lower Columbia River tules (Coweeman River)	Lower Columbia River brights (North Fork Lewis River)	Snake River A-run Steelhead	Snake River B-run Steelhead
1980	65%	85%	70%		
1981	68%	76%	42%		
1982	63%	77%	48%		
1983	66%	63%	43%		
1984	76%	72%	58%		
1985	73%	62%	57%	19.3%	31.0%
1986	75%	73%	66%	12.6%	26.7%
1987	76%	72%	68%	14.7%	37.20%
1988	81%	84%	70%	16.1%	23.5%
1989	77%	68%	46%	14.9%	35.0%
1990	78%	67%	41%	14.1%	21.6%
1991	67%	69%	59%	14.4%	30.0%
1992	62%	66%	59%	15.2%	26.3%
1993	63%	60%	55%	14.6%	19.2%
1994	48%	34%	41%	9.7%	18.6%
1995	43%	36%	38%	10.0%	18.4%
1996	39%	26%	19%	8.6%	35.0%
1997	51%	39%	29%	10.0%	14.3%
1998	41%	29%	21%	8.4%	15.5%
1999	48%	45%	21%	7.8%	8.9%
2000	47%	40%	25%	4.3%	13.2%
2001	38%	39%	30%	3.8%	11.5%
2002	48%	49%	48%	2.7%	3.4%
2003	46%	44%	53%	4%	16.6%
mean 80-95	**66%**	**64%**	**52%**		
mean 96-03	**45%**	**39%**	**31%**		
mean 85-97				**13.4%**	**25.9%**
mean 98-03				**5.2%**	**11.5%**

<u>Chum Salmon</u>

Chum salmon are not caught in ocean salmon fisheries off the Washington, Oregon, and California coast managed by the PFMC (NMFS 2001a). There are fisheries directed at chum in Puget Sound and in Canada and Alaska that generally target maturing fish returning to nearby terminal areas in the fall. We have no specific information on the ocean distribution of Columbia River chum salmon, but given the timing and distant location of fisheries directed at chum, it is unlikely that Columbia River chum are significantly affected by ocean fisheries.

2.2.4.2 Columbia Basin Harvest

There is some harvest of listed species considered in the biological opinion that occurs within the action area, but outside the scope of the proposed fall season fisheries. This includes Indian and non-Indian harvest during the 2004 winter, spring, and summer season fisheries covered under an earlier biological opinion (NMFS 2001b), and tributary recreational fisheries that are being considered separately under section 4d of the ESA. The harvest rates associated with these fisheries are summarized in Table 10.

Table 10. Expected harvest rates to listed salmonids that will occur within the action area, but outside the scope of proposed fall season fisheries. Included are impacts to listed salmonids in 2004 Columbia River basin winter, spring, and summer season fisheries in the mainstem Columbia River. Also shown are impacts associated with tributary recreational steelhead fisheries in Idaho. (NA - similar estimates not available for other areas.)

Evolutionarily Significant Unit (ESU)	Non-Indian fisheries		Treaty Indian fisheries
	(wtr/spr/sum)	Tributary fisheries	(wtr/spr/sum)
Lower Columbia River chinook	2.7%[a]	NA	0
Snake River steelhead			
A-run	0.2%	2.5%[c]	2.7%[b]
B-run	0	2.5%[c]	[b]
Upper Columbia River steelhead			
Naturally-produced	0.6%	0	3.8%
Hatchery-produced	4.5%	0	2.7%
Mid-Columbia River steelhead	<2.0%[d]	NA	3.6%
Lower Columbia River steelhead	<2.0%[d]	NA	1.6%
Columbia River chum	0	[e]	0
Snake River sockeye	<1.0%	0	<7.0%

[a] Spring component of the Lower Columbia River ESU only.
[b] B-run steelhead of the current return year are primarily caught in fall season fisheries. However, a portion of the summer steelhead run holds over in the Lower Columbia River above Bonneville dam until the following winter and spring; these fish, thought to be mostly A-run, are caught in fisheries in those seasons.
[c] Maximum harvest rate applied to wild fish passing through terminal fishery areas where hatchery fish are being targeted; hooking mortality of 5% applied to an assumed 50% encounter rate. Harvest rates to stocks not passing through targeted terminal fishing areas will be less.
[d] Preseason impacts limits; postseason estimates not yet available.
[e] Chum may be taken occasionally in tributary fisheries below Bonneville Dam. Retention is prohibited.

2.2.5 Natural Conditions

Natural changes in the freshwater and marine environments play a major role in salmonid abundance. Recent evidence suggests that marine survival among salmonids fluctuates in response to 20- to 30-year cycles of climatic conditions and ocean productivity (Hare et al. 1999). This phenomenon has been referred to as the Pacific Decadal Oscillation; this has also been referred to as the Bidecadal Oscillation (Mantua et al. 1997). The variation in ocean conditions has been an important contributor to the decline of many stocks. It is apparent that ocean conditions that affect the productivity of Pacific northwest salmon populations have been in a low phase of the cycle for some time. However, recent information suggests that ocean conditions may have undergone a substantive change beginning in 1999 as indicated by cooler ocean temperatures, changes in species composition of zooplankton, fewer pelagic predators such as hake and mackerel, and the increased abundance of bait fish (B. Emmett, NMFS, pers. comm., w/ P. Dygert, NMFS, June 7, 2001). Many stocks in the Columbia Basin and along the west coast have shown substantial increases in abundance, in some cases to record levels in recent years.

The effect of improving ocean conditions is discussed in the recent proposed listing notice (69 FR 33102, June 14, 2004). In summary, the FR notice cautions that even under the most optimistic scenario, increases in abundance might be only temporary and could mask a failure to address underlying factors for decline. The real conservation concern for West Coast salmon and *O. mykiss* is not how they perform during periods of high marine survival, but how prolonged periods of poor marine survival affect the VSP parameters of abundance, growth rate, spatial structure, and diversity. It is reasonable to assume that salmon populations have persisted over time, under pristine conditions through many such cycles in the past. Less certain is how the populations will fare in periods of poor ocean survival when their freshwater, estuary, and nearshore marine habitats are degraded.

Salmon and steelhead are exposed to high rates of natural predation, particularly during freshwater rearing and migration stages. Ocean predation may also contribute to substantial natural mortality, although it is not know to what degree. In general, salmonids are prey for pelagic fishes, birds, and marine mammals, including harbor seals, sea lions, and killer whales. There have been recent concerns that the rebound of seal and sea lion populations – following their protection under the Marine Mammal Protection Act of 1972 – has caused a substantial number of salmonid deaths.

2.2.6 Summary

In conclusion, given all the factors for decline—even taking into account the corrective measures being implemented—it is still clear that the affected ESU's biological requirements are currently not being met under the environmental baseline. Some of the ESUs are responding favorably to improved natural conditions and actions taken to reduce human-induced mortality. However, the survival and recovery of the species depends on their ability to also persist through periods of low ocean survival. Thus circumstances are such that there must be a continued improvement in the environmental conditions (over those currently available under the environmental baseline). Any further degradation of the environmental conditions could have a large impact because these ESUs are already at risk. In addition, efforts to minimize impacts caused by dams, harvest, hatchery operations, and habitat degradation must continue.

3.0 EFFECTS OF THE ACTION

The purpose of this section is to identify what effects NMFS' issuance of an incidental take statement will have on ESA listed salmonid ESUs in the Columbia River. To the extent possible, this will include analyzing effects at the population level. Where information on listed salmonid ESUs is lacking at the population level, this analysis assumes that the status of each affected population is parallel to that of the ESU as a whole. The method NMFS uses for evaluating effects is discussed first, followed by discussions of the general effects fishery activities are known to have.

3.1 Evaluating the Effects of the Action

3.1.1 Applying ESA section 7(a)(2) standards

Over the course of the last decade and hundreds of ESA section 7 consultations, NMFS developed the following four-step approach for applying the ESA section 7(a)(2) standards when determining what effect a proposed action is likely to have on a given listed species. What follows here is a summary of that approach; for more detail please see *The Habitat Approach: Implementation of Section 7 of the Endangered Species Act for Actions Affecting the Habitat of Pacific Salmonids* (NMFS 1999b).

1. Define the biological requirements and current status of the listed species.

2. Evaluate the relevance of the environmental baseline to the species' current status.

3. Determine the effects of the proposed or continuing action on listed species and their habitat.

4. Determine whether the species can be expected to survive with an adequate potential for recovery under (a) the effects of the proposed (or continuing) action, (b) the effects of the environmental baseline, and (c) any cumulative effects, including all measures being taken to improve salmonid survival and recovery.

Information related to steps one and two is discussed in preceding sections. Information related to steps three and four are is discussed below.

The fourth step above requires a two-part analysis. The first part focuses on the action area and defines the proposed action's effects in terms of the species' biological requirements in that area.

The second part focuses on the species itself. It describes the action's impact on individual fish—or populations, or both—and places that impact in the context of the ESU as a whole. Ultimately, the analysis seeks to answer the questions of whether the proposed action is likely to jeopardize a listed species' continued existence or destroy or adversely modify its critical habitat.

3.2 Effects on Habitat

Previous sections have described the habitat of the affected ESA listed ESUs in the Columbia River, the essential features of that habitat, and depicted its present condition. The discussion here focuses on how those features are likely to be affected by the proposed action.

Most of the harvest related activities occur from boats or along river banks. The gears that would be used include hook-and-line, drift and set gillnets, and hoop nets. These types of gear do not substantially affect the habitat. There will be minimal disturbance to vegetation, and negligible harm to spawning or rearing habitat, or to water quantity and water quality. Thus, there will be minimal effects on the essential habitat features of the affected species from the actions discussed in this biological opinion, certainly not enough to contribute to a decline in the values of the habitat. While harvest activities do affect passage in that fish are intercepted, those impacts are accounted for explicitly in the following analyses regarding harvest related mortality.

3.3 Effects on ESA Listed Salmonid ESUs

3.3.1 Factors to Be Considered

Fisheries may affect salmonid ESUs in several ways which have bearing on the likelihood of continued survival of the species. Immediate mortality effects accrue from the hooking or netting and subsequent retention of individual fish — those effects are considered explicitly in this opinion. In addition, mortalities may occur to any fish which is caught and released alive This is important to consider in the review of fishery management actions, as catch-and-release mortalities primarily result from implementation of management regulations designed to reduce mortalities to listed fish through live release. The catch-and-release mortality rate varies for different gear types, different species, and different fishing conditions, and those values are often not well known. Catch-and-release mortality rates have been estimated from available data and applied by the TAC in the calculation of impacts to listed fish evaluated in this consultation. The TAC applies a 10% incidental mortality rate to salmon caught and released during recreational fishing activities. The TAC also applies a 1% incidental mortality rate to salmon caught and released using dipnets. Estimates of catch-and-release mortality are combined with landed catch estimates when reporting the expected total mortality, and so are also specifically accounted for in this biological opinion.

The states and tribes propose to manage their fisheries subject to various harvest rate caps for individual ESUs or ESU components. In some cases the parties presume that the fisheries will be managed up to the specified limit or cap. In other cases, there are differences between the harvest rate cap and the expected harvest rate, which is less than the cap. For example, Snake River fall chinook are considered one of the key limiting stocks, and fisheries are likely to be managed up to the 31.29% harvest rate limit. Alternatively, the states propose to manage their fisheries subject to a 2% harvest rate limit on natural-origin steelhead. However, the expectation is that the chinook limit will be reached before the steelhead limit is reached. The expected harvest rate on A-run steelhead for each of the ESUs is generally less than 2% (Table 10). In discussing the effects of the action, a distinction is therefore made, where appropriate, between a proposed harvest rate cap and the anticipated harvest rate resulting from the proposed fishery.

3.3.2 Effects of the Proposed Action

The states and tribes propose fisheries with several management objectives that are described in the biological assessment (LeFleur 2004) and the associated 2004 Management Agreement (U.S. v Oregon Parties 2004).

Snake River Fall Chinook

The state and tribal parties propose to manage their fisheries subject to a harvest rate cap of 31.29% on Snake River fall chinook. This harvest rate represents a 30% reduction in the harvest rate relative to the 1988-93 base period. The parties have further agreed to allocate the harvest rate cap 8.25% to non-Indian fisheries and 23.04% to tribal fisheries. Both the Indian and non-Indian allocations result from a court-approved settlement of litigation in U.S.v. Oregon in 2001, and have been used as interim allocations in all subsequent agreements for management of fall fisheries under U.S. v. Oregon, pending the parties' reaching agreement on a new long-term settlement.

Lower Columbia River Chinook Salmon

The tribal fall season fisheries are not likely to affect any of the components of the Lower Columbia River ESU, which return primarily to tributaries below Bonneville Dam. The proposed state fisheries are not likely to affect the spring component of the Lower Columbia River ESU. The expected non-Indian harvest rate on Lower Columbia River tule stocks in the proposed fisheries is 12.4% (Table 10). Additionally, NMFS has developed a combined ocean/freshwater Adult Equivalent (AEQ) Recovery Exploitation Rate (RER) of 49% based on the Coweeman tule population. NMFS previously provided guidance to the Pacific Fishery Management Council (PFMC) indicating that ocean and inriver fisheries should be managed such that the total exploitation rate from all fisheries does not exceed 49% (Lohn and McInnis 2004). Using the AEQ exploitation rate from the Washington component of the Lower Columbia River Hatchery stock as a surrogate for the exploitation rate on naturally spawning tule fall chinook yields a combined ocean/freshwater AEQ exploitation rate of 47% (39% ocean and 8% freshwater, see Table 10 in LeFleur 2004). There may be some confusion in comparing an inriver harvest rate and the freshwater component of a total exploitation rate. In this case, the 12.4% harvest rate is equivalent to an 8% exploitation rate. Consistent with NMFS earlier guidance, NMFS expects that the inriver fisheries will be managed subject to the 49% total AEQ exploitation rate.

The North Fork Lewis River population is used as an indicator for managing bright stocks in the Lower Columbia River ESU. As indicated in the earlier discussion regarding the status of the species (see section 2.1.2), the Lewis River bright stock has consistently met or exceeded its escapement goal of 5,700. The parties propose to manage the fishery to meet the escapement goal. The expected inriver harvest rate on the Lewis River stock is 11.8% (Table 10) with and expected ocean escapement of 23,400.

Table 10. Harvest rates on listed salmonids associated with proposed 2004 fall season fisheries in the Columbia River basin by Evolutionarily Significant Unit (ESU).

ESU	Non-Indian fisheries	Treaty Indian fisheries	Total
Snake River fall chinook	8.25%[a]	23.04%	31.29%
Lower Columbia River chinook			
Spring component	0%	0%	0%
Tule component	12.4%	0%	12.4%
Bright component	11.8%[a]	0%	11.8%
Snake River steelhead			
A-run	≤2% (1.1%)[a]	3.4%[a]	5.4% (4.5%)[a]
B-run	≤2% (1.7%)[a]	15% (13.6%)[a]	17% (15.3%)[a]
Upper Columbia River steelhead			
Natural-origin	≤2% (1.1%)[a]	3.4%	5.4% (4.5%)[a]
Hatchery-origin	10.9%	5.7%	16.6%
Mid-Columbia River steelhead	≤2% (1.1%)[a]	3.4%	5.4% (4.5%)[a]
Lower Columbia River steelhead	≤2% (0.3%)[a]	0.1%	≤2% (0.4%)[a]
Columbia River chum	5% (1.6%)[a]	0%	5% (1.6%)[a]
Snake River sockeye	0%	0%	0%

[a] Maximum proposed harvest rates with the actual expected harvest rates associated with the proposed fisheries shown in parenthesis.

Chum Salmon

Chum salmon are not caught in tribal fisheries since the remaining populations are all located below Bonneville Dam. Retention of chum salmon in state recreational fisheries is prohibited.

The catch of chum is relatively rare in any case since chum do not actively take sport gear generally used to target other species. Impacts in the recreational fishery would be from non-retention mortalities and are expected to be zero in 2004 (LeFleur 2004).

The migration timing of chum salmon is late enough that they are missed by most of the states' proposed lower river commercial fisheries. There is some incidental catch during fisheries in late September and October directed primarily at coho. Commercial landings of chum have averaged 49 fish since 1995. The TAC estimated that the total harvest rate would be less than 1.6% (Table 10), well below the proposed 5% harvest rate limit. The TAC further indicated that the harvest rate projection was likely a maximum value since it is based on a minimum estimate of run size.

<u>Coho Salmon</u>
There are two remaining populations in the Lower Columbia River coho ESU with appreciable natural production in the Clackamas and Sandy rivers in Oregon. These include both early and late timing populations that were characteristic of the ESU. In both cases, escapement information is enumerated through dam counts which provide long time series of abundance data (Table 4). For these reasons, the Sandy and Clackamas populations are used as indicators for assessing harvest impacts.

The state of Oregon listed coho as endangered under the state ESA in July 1999. ODFW subsequently developed a management plan which includes a harvest rate matrix based on marine survival and parent spawner status to determine annual ocean and in-river exploitation rates for Lower Columbia River coho. The matrix has been used for management of ocean and Columbia River fisheries since 2002. (The anticipated exploitation rate in the 2004 ocean fisheries that are managed under the jurisdiction of the Pacific Fishery Management Council is 13.7%. NMFS did not conduct an ESA Section 7 conference on the proposed ocean fisheries in 2004 since the regulatory review occurred prior to the proposed listing of Lower Columbia River coho.) For 2004, the ODFW plan allows for a 15% harvest rate for Lower Columbia River coho for the Columbia River fisheries. Management considerations for coho and other species led to a lower expected harvest rate. The states of Oregon and Washington propose to manage the fisheries using block closures, expanded river mouth sanctuaries, mesh size restrictions, and selective fisheries to minimize the impacts to Lower Columbia River coho and other species of concern. As a result of these management actions, the expected harvest rate associated with proposed state fisheries in 2004 is 6.4% (LeFleur 2004). However, most of the fisheries are scheduled to occur prior to mid-October and prior to the ocean escapement of most late timed natural origin fish. As a result, the early and late timed natural populations are subject to different harvest rates. The anticipated harvest rate on early and late timed natural origin coho in 2004 are 7% and 1%, respectively (pers. comm. Curt Melcher, ODFW, July 26, 2004).

Harvest impacts to natural origin Lower Columbia River coho in the treaty Indian fisheries are expected to be near zero. All Tribal harvest occurs above Bonneville Dam. Only three of the 21 remaining populations in the Lower Columbia River ESU are located above Bonneville Dam. A fourth population located above Bonneville Dam in the White Salmon River was extirpated because of the blockage by Condit Dam on the lower river. There may be some natural production in the other population areas, but it is presumed to result largely from stray hatchery fish. Tribal fisheries for coho are also limited. The tribes do not target coho in the mainstem. Fisheries directed at chinook salmon are generally over by late September prior to peak passage of coho at Bonneville. The catch of coho in the tribes' mainstem fishery has ranged from 500 - 6,300 since 1999 representing an average of 3.5% of the run past Bonneville Dam (LeFleur 2004). The only proposed tributary fishery within the boundary of the Lower Columbia River ESU is in Drano Lake at the mouth of the White Salmon River which also would have little impact on natural origin fish. There are two hatchery programs located above Bonneville that are proposed to be include in the ESU. The tribal fishery will affect a representative fraction of returning hatchery fish, and will presumably have a similar effect on any natural-origin production that may occur from the three Lower Columbia River coho populations located above Bonneville Dam. However, the resulting harvest rate on the Lower Columbia River coho ESU as a whole will be negligible.

Steelhead

The Lower Columbia River and Middle Columbia River steelhead ESUs include both winter and summer-run stocks. Because of their timing, fall season fisheries affect only summer-run steelhead. Winter-run steelhead returning to the Lower Columbia River, and Middle Columbia River ESUs are therefore unaffected by the proposed fall season fisheries.

The tribes propose to manage their fisheries subject to a 15% harvest rate limit on natural-origin Snake River Group B Index steelhead (LeFleur 2004, U.S. v Oregon Parties 2004). The expected incidental harvest rates on natural-origin Snake River A and B-run steelhead associated with the proposed tribal fisheries are 3.4% and 13.6%, respectively (Table 10).

Summer steelhead returning to the other ESUs are all A-run fish. The expected harvest rate in tribal fisheries on Upper Columbia River steelhead is 3.4% and 5.7% for the listed natural-origin and hatchery-origin fish, respectively. The expected harvest rate on natural-origin Middle Columbia River and Lower Columbia River steelhead are 3.4% and 0.1%, respectively (Table 10).

The states proposed to manage their fisheries subject to a 2% harvest rate limit for all natural-origin steelhead. The expected harvest rates associated the states' proposed fisheries are actually less than the proposed 2% cap and vary slightly by ESU. The expected harvest rates for natural-origin Upper Columbia River, Snake River A and B-run, Middle Columbia River, and Lower Columbia River are 1.1%, 1.1%, 1.7%, 1.1%, and 0.3%, respectively. The expected harvest rate on listed hatchery-origin steelhead from the Upper Columbia River ESU is 10.9% (Table 10).

4.0 CUMULATIVE EFFECTS

Cumulative effects are those effects of future tribal, state, local or private activities, not involving Federal activities, that are reasonably certain to occur within the action area. For the purpose of this analysis, the action area is that part of the Columbia River basin described in section 1.2 above. Future Federal actions, including the ongoing operation of hydropower systems, hatcheries, fisheries, and land management activities will be reviewed through separate section 7 consultation processes. Non-Federal actions that require authorization under section 10 of the ESA, and that are not included within the scope of this consultation, will be evaluated in separate section 7 consultations.

Future tribal, state and local government actions will likely to be in the form of legislation, administrative rules, or policy initiatives, and land use and other types of permits. Government and private actions may include changes in land and water uses, including ownership and intensity, any of which could impact listed species or their habitat. Government actions are subject to political, legislative and fiscal uncertainties. These realities, added to geographic scope of the action area which encompasses numerous government entities exercising various authorities and the many private landholdings, make any analysis of cumulative effects difficult and, frankly, speculative.

Non-Federal actions on listed species are likely to continue affecting listed species. The cumulative effects in the action area are difficult to analyze considering the geographic landscape of this biological opinion, and the political variation in the action area, the uncertainties associated with government and private actions, and the changing economies of the region. Whether these effects will increase or decrease is a matter of speculation; however, based on the trends identified in this section, the adverse cumulative effects are likely to increase. Although state, tribal and local governments have developed plans and initiatives to benefit listed fish, they must be applied and sustained in a comprehensive way before NMFS can consider them "reasonably foreseeable" in its analysis of cumulative effects.

5.0 INTEGRATION AND SYNTHESIS OF EFFECTS

5.1 Snake River Fall Chinook

Snake River fall chinook are expected to be one of the principle limiting stocks in the fall season fisheries. In recent years, these fisheries have been subject to ESA take limitations and required to reduce the harvest rate on Snake River fall chinook by 30% relative to the 1988-93 base period. This translates into an overall inriver harvest rate of 31.29%. The states and tribes again propose to manage their fisheries for 2004 within the harvest rate limit, and allocate the 31.29% harvest rate between the proposed state and tribal fisheries - 8.25% and 23.04%, respectively.

NMFS first implemented the 30% base period reduction criterion as a standard for evaluating fall season fisheries in 1996 associated with its review of the 1996-1998 Fall Season Agreement (NMFS 1996). The 1999 fall season biological opinion again (NMFS 1999b) reviewed the history and considerations used in developing the 30% base period reduction standard. As indicated, this standard was derived largely based on then available information regarding the level of harvest rate reduction that was necessary and sufficient to avoid appreciably reducing the likelihood of survival and recovery of the species in the wild. At the time, no quantitative analyses were available that could determine the effect of harvest impacts, in combination with other mortality factors, on the likelihood of survival and recovery. It was clear, however, that the species had declined to low levels under the existing baseline conditions and that survival improvements were required across all sectors, including harvest. The 30% reduction, in combination with an analogous reduction in ocean fisheries, was considered a significant reduction to address, at least initially, the need for survival improvements in harvest given the current status of the stock and other anticipated actions. Incorporated into that consideration was a willingness to accept some increase in the risk to the species associated with higher harvest rates and fishery needs that were primarily related to the tribes' treaty fishing rights. The judgment made at the time was that the 30% base period reduction standard provided the appropriate balance without putting the species at undue risk. The standard was adopted in a biological opinion regarding the 1996-1998 Fall Season Agreement with the explicit provision that it would be reviewed and revised if necessary based on best available information (NMFS 1996b). In fact, in the 1999 biological opinion, NMFS removed a provision in the 1996-1998 Agreement that allowed for a higher harvest rate under certain conditions, and rejected a proposal that argued for a higher harvest rate based on new information which purportedly demonstrated an improvement in the status of the stock. The 1999 opinion reaffirmed the 30% reduction standard which has been applied consistently to the present time.

As indicated above considerations related to trust obligations and treaty rights were central to the development of the 30% harvest reduction standard. Since the initial listings of Pacific salmon in 1991 NMFS has sought to resolve and articulate its policy related to tribal treaty obligations and trust responsibilities as they related to implementation of the ESA. One result of these deliberations was a statement of policy that was included in the 1995 Proposed Recovery Plan for Snake River Salmon (NMFS 1995). Among other things the Proposed Recovery Plan confirmed that the Federal government should be guided by what are commonly known as the Conservation Necessity Principles when implementing the ESA. The conservation necessity principles are standards developed through the Federal courts that articulate necessary conditions for imposing conservation restrictions on treaty reserved fishing rights. The Conservation Necessity Principles indicate that such restrictions will be not be imposed unless:

1. the restrictions are reasonable and necessary for the conservation of the fishery resource;
2. the restrictions are the least restrictive measures available to achieve the conservation purpose;
3. the restrictions, either as stated or as applied, do not discriminate against treaty activities;
4. the restrictions are necessary because the conservation purpose cannot be achieved through reasonable regulation of non-treaty activities; and

5. the restrictions are necessary because voluntary tribal conservation measures are not adequate to achieve the conservation purpose.

Policy commitments such as those described in the Proposed Recovery Plan provided guidance for subsequent consultations on fisheries, particularly as NMFS sought an appropriate balance between trust obligations and the imperative of meeting the conservation needs of the listed species. The guidance was incorporated in the 1996 and 1999 biological opinions (NMFS 1996, 1999b) on fall season inriver fisheries (the 1996 opinion covered proposed fisheries from 1996 - 1998) that provided the basis for the current harvest standard. The policy commitment and guidance related to treaty rights was reiterated in other documents and correspondence, including the Federal Caucus' Final Basinwide Salmon Recovery Strategy (Federal Caucus 2000) (generally referred to as the All-H paper) and subsequent consultations on harvest.

Federal court decisions have clarified that the tribes have a treaty right is to harvest up to 50% of the harvestable surplus of fish passing through a tribes' usual and accustom fishing areas. Harvestable surplus is defined conceptually as runsize minus the escapement goal. During fall season fisheries the tribes' primary target is fall chinook from the Upper Columbia River summer/fall chinook ESU which spawn on the Hanford Reach. This ESU is not listed and in fact is healthy. The fall component of the ESU that is targeted in the fishery has exceeded its escapement goal by a wide margin in every year since 1982. In 2004, as in past years, the tribes have proposed to voluntarily forego some harvest in order to reduce harvest on listed Snake River fall chinook and other species of concern. Under the proposed fishery plan, the tribes would limit their harvest because of conservation concerns for Snake River fall chinook and, as a result, expect to harvest only 36% of the harvestable surplus of Upper Columbia River fall chinook. Harvest opportunity on other species, particularly steelhead, would also be substantially limited.

A further consideration in evaluating the status of Snake River fall chinook has been the existence of four artificial propagation programs producing Snake River fall chinook. These rely on the Lyons Ferry Hatchery stock and include a substantial reservoir of fall chinook that are part of the ESU. Although hatchery fish are not a substitute for recovery, they do provide a further safeguard against catastrophes or continuing failures of the natural system that reduces the risk of species extinction. In this case, the Lyons Ferry Hatchery is used to maintain a brood stock, and is also used as a source for a very substantial supplementation program. The supplementation program has been scaled up over the last several years to provide both fingerling and yearling outplants that are acclimated and released in areas above LGD. The immediate objective of the supplementation program is to increase the number of natural-origin spawners. The return of adults to LGD from the supplementation program has increased from 479 in 1998 to over 8,500 in 2003. This is in addition to the adults returning from natural production (see Table 3).

The return of fish from the supplementation program is not a substitute for recovery which depends on the return of self-sustaining populations in the wild. However, supplementation can be used to mitigate the risk of extinction by boosting the initial abundance of spawners while other actions are taken to increase the productivity of the system to the point where the population is self sustaining and supplementation is no longer required. Collectively, artificial propagation programs in the ESU provide slight benefits to ESU abundance, spatial structure, and diversity, but have neutral or uncertain effects on ESU productivity (69 FR 33102, June 14, 2004).

In considering the proposed 2004 fisheries, it is also appropriate to review the magnitude of harvest reductions and the change in spawner escapements in recent years. The average harvest rate of Snake River fall chinook in the Columbia River since 1996 is 27%, actually lower than the 31.29% limit. Taken from a broader perspective we can look at the combined impact of ocean and inriver fisheries and how that has changed over the last 20 years. The exploitation rate on Snake River fall chinook in the ocean and inriver fisheries combined has declined from an average of 67%, from 1986-1995, to 45%, since 1995, representing a 33% reduction in the overall exploitation rate. The abundance of Snake River fall chinook has increased in recent years. The return of natural-origin chinook to LGD averaged 407 adults from 1980-1995 (range 78-742) including a low in 1990 of just 78 fish. The average return to LGD from 1996-2000 was 759 (range 306-1,148, Table 3). The average return of natural origin fish from 2001-2003 was 3,725. We do not currently have a forecast for the return of natural-origin Snake River fall chinook to LGD for 2004, but the river mouth run size is expected to be similar to that observed in 2003 suggesting another strong return of Snake River fall chinook in 2004.

Other available abundance indicators reflect a similar pattern of substantial increase in recent years. The number of redds, smolt out-migrants at Lower Granite Dam, and jacks all increased over the last four or five years (see Figures 2 to4).

The adult returns observed in recent years can be compared to the previously identified lower abundance threshold of 300 and recovery escapement goal of 2,500 which are the kinds of benchmarks suggested in the VSP paper (McElhany et al. 2000) for evaluating populations status. NMFS has more recently reaffirmed the use of 2,500 as an interim abundance target for Snake River fall chinook pending development of final recovery goals through the recovery planning process (Lohn 2002). Escapements in prior years have been well below goal, but also consistently above the lower abundance threshold. (This lower threshold is considered indicative of increased relative risk to a population in the sense that the further and longer a population is below the threshold the greater the risk; it was clearly not characterized as a "redline" below which a population must not go (BRWG 1994).) The return of natural origin fish in 2001, 2002, and 2003 approached or exceeded the recovery escapement goal of 2,500, while averaging 3,700, with another strong return expected in 2004. The increase in escapement cannot be attributed directly to decreased harvest, but it does support the initial judgment that the prescribed harvest rates are consistent with expectations of rebuilding to meet survival and recovery goals.

This analysis suggests that harvest reductions and other actions taken to improve survival in recent years have contributed to the species' improving status. The analysis tends to confirm the qualitative considerations that suggested that harvest reductions, along with other actions taken to reduce mortality, were consistent with expectations of survival and recovery and supports their continued use for 2004. However, improved natural conditions have also contributed to the species improved status and it is difficult to sort out the relative contribution of human actions taken to reduce mortality and improved natural conditions. The recent Federal Register notice regarding proposed ESA salmon listings (69 FR 33102, June 14, 2004) emphasizes that improved natural conditions may be transitory and the need for caution against premature conclusions related to species recovery. Survival improvements achieved to date in harvest and elsewhere will remain important to long term recovery until we develop a better understanding of the factors that have contributed to the abundance increases in recent years. Based on these considerations, NMFS concludes that continued reliance on the harvest rate standard used in recent years and the impacts associated with the proposed 2004 fisheries are not likely to appreciably reduce the likelihood of survival and recovery of Snake River fall chinook.

5.2 Lower Columbia River Chinook

The spring component of Lower Columbia River fall chinook are not harvested in the proposed fall season fisheries. Nearly all of the tule and bright stocks of the Lower Columbia River ESU return to tributaries located below Bonneville Dam. Lower Columbia River fall chinook are therefore largely unaffected by fall season tribal fisheries which do not extend below Bonneville.

The fact that these populations have been stable in recent years and that overall harvest mortality has declined by more than half suggests that the 2004 fall season fisheries do not pose a substantial risk to those populations nor limit the potential for longer-term recovery efforts.

Forthcoming results from the ongoing recovery planning efforts will help clarify critical questions related to population structure, recovery objectives, and the role of hatcheries in the recovery effort. Whether additional reductions are needed in harvest will depend on these efforts. But for now, based on the best available information, NMFS concludes that the impacts associated with the proposed 2004 fisheries are not likely to appreciably reduce the likelihood of survival and recovery of Lower Columbia River chinook.

5.3 Chum Salmon

Chum salmon are not caught in tribal fisheries above Bonneville Dam. Chum are caught occasionally in non-Indian fisheries below Bonneville. However, catch rates are quite low. There are no fisheries targeted at hatchery or natural-origin chum. There are also no chum hatchery production programs in the Columbia Basin except for those designed to supplement natural production. The later fall return timing of chum is such that they are vulnerable to relatively little potential harvest in fisheries that target primarily chinook and coho. Chum rarely take the kinds of sport gear that is used to target other species.

Harvest rates are difficult to estimate since we do not have good estimates of total run size. Spawning surveys focus on index areas and so provide estimates for only a portion of the run. However, the incidental catch of chum amounts to a few 10's of fish per year. The harvest rate in proposed state fisheries in the lower river is estimated to be 1.6% and is almost certainly less than 5%. Based on these considerations and other factors discussed above, NMFS concludes that the impacts associated with the proposed 2004 fisheries are not likely to appreciably reduce the likelihood of survival and recovery of Columbia River chum salmon.

5.4 Lower Columbia Coho Salmon

The Sandy and Clackamas river populations are used as indicators for analyzing the impacts of proposed fisheries to natural origin Lower Columbia River coho salmon. The Sandy River stock is an early-timed population. Although there is still some uncertainty on this point, the Clackamas apparently has both early and late timed components with the late population considered to represent the native run (Zhou and Chilcote 2004).

The ODFW developed a plan for managing ocean and inriver fisheries based on escapements and marine productivity. Implementation of that plan in 2004 would allow for an inriver harvest rate of 15%. Recent information suggests that the management plan ought to be reviewed and possibly revised (Zhou and Chilcote 2004). Zhou and Chilcote (2004) analyzed the status of the early and late timed populations in the Clackamas. They concluded that the early timed component is quite productive and can sustain relatively high harvest rates with little risk of extinction. In contrast, the late timed population is less productive and thus not able to sustain comparable harvest impacts. As a result, implementation of ODFW's current harvest rate matrix over the long term may lead to an unacceptably high risk of extinction to at least the later timed populations. Zhou and Chilcote recommended conducting a similar analysis of status, productivity, and the likelihood of extinction for the early timed Sandy River population, but that is not available at this time. However, escapement to the Sandy has averaged almost 900 over the last four years compared to a maximum sustained production escapement goal of 1,500. The spawner-to-spawner return rate has ranged from 1.6 to 6.3 and averaged 3.7 over the same period indicating that the population has been growing in recent years coincident with improved ocean conditions.

Although ODFW's management plan would allow for higher harvest rates, the states of Oregon and Washington proposed more limited fisheries in 2004. The expected harvest rate on Lower Columbia River coho in non-Indian fisheries in 2004 is 6.4%. The anticipated harvest rate on the early and late natural origin components are 7% and 1%, respectively. Any additional impacts on natural origin coho in treaty Indian fisheries will be near zero.

Zhou and Chilcote (2004) concluded that the early population can sustain harvest rates comparable to those proposed in ODFW's management plan over the long term even with relatively conservative assumptions about future marine survival. Harvest rates in 2004 are significantly less than would be allowed under the management plan (13.7% v 30% for ocean fisheries and 7% v 15% for river fisheries). It is therefore reasonable to conclude that the proposed fisheries are not likely to result in a significant risk to early-timed populations.

In contrast, Zhou and Chilcote conclude that the late timed population in the Clackamas was less productive and that implementation of the management plan over the long term may put the population at undue risk. Proposed harvest rates are again less than would be allowed under the plan (13.7% v 30% for ocean fisheries and 1% v 15% for river fisheries). Zhou and Chilcote estimated extinction probabilities for the late population using a range of initial conditions and assumptions. The analysis indicated that the extinction probability is near 0 if the initial population is 100 fish or more and the total harvest rate is less than 20%. Over the last six years (two brood cycles) the escapement of late time coho has ranged from 2 to 1,061 and averaged 319 (Table 4). The analysis is therefore consistent with assumptions related to the initial conditions (100 fish or more) and a harvest rate of less than 20%, and suggests that the fisheries proposed in 2004 are not likely to result in a significant extinction risk to late-timed populations.

A paradoxical characteristic of the Lower Columbia River coho ESU is the relative scarcity of natural origin fish compared to the high abundance of hatchery origin fish that are considered part of the proposed ESU. The existence of these hatchery populations results in both risks and benefits to the species. The extreme loss of naturally spawning populations, the low abundance of extant populations, diminished diversity, and fragmentation and isolation of the remaining naturally produced fish confer considerable risks on the ESU. The paucity of naturally produced spawners in this ESU is contrasted by the very large number of hatchery produced adults. The abundance of hatchery coho returning to the Lower Columbia River over the last three years ranges from 600,000 to more than one million. The magnitude of hatchery production continues to pose significant genetic and ecological threats to the extant natural populations in the ESU. However, these hatchery stocks collectively represent a significant portion of the ESU’s remaining genetic resources. The 21 hatchery stocks considered to be part of the ESU, if appropriately managed, may prove essential to the restoration of more widespread naturally spawning populations. At present, the Lower Columbia River coho hatchery programs reduce risks to ESU abundance and spatial structure, provide uncertain benefits to ESU productivity, and pose risks to ESU diversity. Overall, artificial propagation mitigates the immediacy of ESU extinction risk in the short-term but is of uncertain contribution in the long term (69 FR 33102, June 14, 2004).

5.6 Steelhead

During the course of consultation related to the 2004 fisheries, the state and tribal parties proposed to manage their fisheries subject to the same constraints for steelhead used over the last five years. The states of Oregon and Washington proposed to manage their fisheries using selective fishing techniques and limit the harvest rate on each of the affected ESUs to no more than 2%. The tribes proposed to manage their fishery subject to a 15% harvest rate on Snake River B-run steelhead with the expectation that the impacts will be substantially less for other natural-origin stocks (<1% to < 6%, Table 10). In fact, the expected impacts to B-run steelhead associated with the proposed fisheries are somewhat less than the specified limits (1.7% vs. 2.0% and 13.6% vs. 15%) because the harvest constraints for Snake River fall chinook are likely to be more limiting. Actual harvest rates in recent years have been substantially less than those proposed (Table 8).

As discussed in section 2.2.1.3 in some detail, B-run steelhead are a large and important component of the Snake River ESU that is at risk because of its current depressed status. B-run steelhead are also the component that is most vulnerable to the fisheries due to their later timing, larger size, and upstream location which requires them to pass through the full range of fall season fisheries. A-run steelhead, whether from the Snake River or other ESUs, benefit from the protections provide to B-run steelhead because they are subject to relatively lower harvest rates, again because of their smaller size, earlier timing, and, for the Lower Columbia River and Middle Columbia River ESUs, their downstream location. The winter run component of the Lower Columbia River and Middle Columbia River ESUs are also not subject to harvest in the fall season fisheries. B-run steelhead are therefore considered the most constraining of the steelhead stocks.

Having proposed the above described standard it is necessary in this biological opinion to again consider how it relates to the status of the species and environmental baseline, and whether it remains consistent with a no jeopardy conclusion for Snake River steelhead and other ESUs as well. NMFS here reviews the related considerations, and in the end concludes that reliance on the proposed 2% and 15% harvest rate limits, given the circumstances in 2004, is consistent with a no jeopardy finding. However, NMFS is not satisfied that a 17% harvest rate cap represents an appropriate long term plan that can be implemented regardless of the status of the species. Developing an alternative management plan that is more responsive to species abundance depends, in part, on resolving uncertainties related to escapement objectives for the listed steelhead ESUs. The TAC's (2002) recent report on Snake River steelhead escapements helps resolve some of the uncertainty, although the interested parties have yet to identify specific management objectives for Snake River steelhead. Another impediment to implementing an abundance-based management plan is the inability to predict preseason abundance. The U.S. v. Oregon Parties are currently engaged in the development of a new Columbia River Fish Management Agreement that would include management provisions for Snake River steelhead. The Agreement, when completed, would be the subject of a future ESA section 7 review.

As an initial matter in considering whether expected impacts to B-run steelhead are acceptable it is important to acknowledge that Snake River B-run steelhead and thus the ESU is at risk of extinction as is indicated by their status as part of the listed ESU. This has come about as a result of the effects of a broad range of past and ongoing human activities and natural factors that comprise the environmental baseline which in aggregate have contributed to their decline and led to the current status of the species. The fisheries being considered here are not the last in a chain of sequential events that have put these species at risk. They are instead one action in a continuous cycle of actions that have contributed to the decline of the species. Clearly, if the aggregate effects of all mortalities are not significantly reduced and maintained at lower levels for the foreseeable future, the species will not recovery.

Any harvest, or any action that involves take for that matter, involves some increase in the level of risk to the species. The tribes' views regarding the assumption of risk associated with their fisheries have substantial merit. The tribes have both a right and priority to conduct their fisheries within the limits of conservation constraints. Because of the Federal government's trust relationship with the tribes, NMFS is committed to consider the tribes' judgment and expertise when it comes to the conservation of trust resources. However, the opinion of the tribes and their immediate interest in fishing must be balanced against NMFS' responsibility pursuant to the ESA to ensure the survival and recovery of listed species and its trust responsibility which requires consideration of the long-term interests of the tribes as well. The tribes' long-term interests clearly require that the fishery resources be conserved even if it requires compromising short-term fishing objectives.

Steelhead impacts associated with fall season fisheries were managed from 1985 to 1997 pursuant to the guidelines contained in the now expired CRFMP. That plan allowed for a tribal harvest rate on B-run steelhead during the fall season of 32%. The 32% cap was itself a reduced fishing level designed at the time to provide necessary protection to B-run steelhead. The average B-run harvest rate from 1985 to 1997 was 26.0% (Table 8). Beginning in 1998 when ESA constraints specific to B-run steelhead were first applied, the harvest rate in the tribal fall season fishery has averaged 11%. The 15% harvest rate cap represents a 42% reduction from the long-term average harvest rate for the tribal fishery, and a 53% reduction from the CRFMP allowed harvest rate of 32%. The expected harvest rate on B-run steelhead in the tribes' 2004 fall season fisheries is 14.9%.

The harvest rate on Snake River A-run steelhead averaged 13.4% from 1985 to 1997. The average harvest rate over the last six years has been 5.2% (Table 8). The expected harvest rate on Snake River A-run steelhead in this years' fall season fishery is 4.5% (Table 10).

In recent years, the tribes took additional management action designed to further reduce the incidental catch of steelhead in the fall season fishery. It was generally understood that steelhead catch rates could be reduced by using larger mesh gillnets. In 1997 and 1998 pilot studies were conducted that confirmed that nine inch mesh gillnets caught significantly fewer steelhead compared to the six, seven, and eight inch nets that were used most frequently during the fishery. Based on these results an agreement was reached in 2000 to purchase and distribute nine inch mesh gillnets in exchange for a commitment by each fishermen receiving the nets to use them whenever they participate in the fall fishery for the next five years. Although nets typically deteriorate with use and are ultimately phased out, some of the purchased nets remain in the fishery and thus help minimize incidental impacts to steelhead. In 2002, the tribes instituted an eight inch minimum size requirement, and took other voluntary actions to help keep steelhead impacts low.

Non-Indian fishermen have also taken significant action to reduce steelhead catch rates. The most significant management actions in the non-Indian fisheries related to steelhead occurred several years ago. Managers for the non-Indian fisheries took a more regulatory approach designed to reduce the impact of their fisheries on wild steelhead in particular. Commercial harvest of steelhead by non-Indians has been prohibited since 1975; time, area, and gear restrictions limit handling and mortality of steelhead by the non-Indian gillnet fishery to < 1% of the run. In addition, all sport harvest is now restricted to fin-clipped hatchery steelhead only. Anglers have been required to release natural-origin steelhead in the Columbia River since 1986. Of the fish that are caught and released, it is assumed that 10% will die from resulting injuries. Because of these conservation related actions, non-Indian fisheries are being managed under a 2% harvest rate cap. The expected harvest rate on Snake River A- and B-run steelhead in the proposed 2004 non-Indian fisheries are 1.0% and 1.7%, respectively (Table 10).

As discussed in section 2.2.5 of this opinion, it is apparent that ocean conditions have improved since approximately 1999, and that many of the stocks are responding favorably to those changing conditions. In the last three years there have been record returns of upriver spring chinook including the return of over 400,000 adults to Bonneville Dam in 2001 and over 300,000 in 2002, both records since counts began in 1938. The return of upriver spring and summer chinook in 2004 is lower than the record returns of the last two years, but at 180,000 and 120,000, respectively, still significantly higher that preseason expectations or returns in the prior 30 years. Steelhead have shown similar increases in recent years (Figures 7 and 8).

We can not be sure that the improved conditions observed in recent years and being observed this year will persist. However, these conditions are more likely to persist if the recent observations portend a shift in the Pacific Decadal Oscillation. Improving ocean conditions may help offset some of the negative affects of the 2001 drought. Improving conditions are not a substitute for sustained improvements in the freshwater habitat conditions, but will certainly help by providing the time necessary to bring the improvements on line.

For now NMFS is satisfied that steelhead harvest rates have been substantially reduced in recent years, that further actions are being taken to reduce harvest, and that the expected impacts associated with this year's fisheries are sufficiently low to avoid jeopardizing the species. This conclusion is supported by recent upward trends and apparently improved ocean conditions. Although the discussion and analysis in this biological opinion has focused largely on Snake River B-run steelhead it is pertinent to recall that the expected harvest rates on other steelhead are substantially lower. The expected harvest rates on Snake River and Upper Columbia River A-run stocks is 4.5%. The expected harvest rates on the summer components of Middle Columbia River and Lower Columbia River steelhead are less then 4.5% and less than 1%, respectively (Table 10).

NMFS, as a matter of policy, has not sought to eliminate harvest and as discussed in this biological opinion and elsewhere has accepted a certain measure of increased risk to the species to provide limited harvest opportunity, particularly to the tribes in recognition of their treaty rights and the Federal government's trust responsibility. Non-treaty fisheries are second in priority to tribal fisheries when it comes to fisheries that are limited by conservation constraints. But here too NMFS will seek, as a matter of policy, to provide some opportunity to access harvestable fish if the states and tribes can resolve critical questions related to allocation and with the proviso that the impacts are very limited and all possible measures are taken to minimize the incidental impacts to listed species. The implementation of steelhead mass marking and selective, non-retention fisheries by the northwest states serves as an example. Even so, the associated impacts must be accounted for and held to acceptable levels.

NMFS believes that the harvest needs of the states and tribes during an interim period of recovery can best be achieved through a transition to selective fishery methods that can minimize the impacts to listed species and other weak stocks that require protection. NMFS' acceptance of the harvest rate standards for this year provides an opportunity to make necessary adjustments in the fisheries with a minimum of disruption. But ultimately fisheries will be managed, and catch will continue to be limited, based on the needs of the listed fish. NMFS also believes that fisheries should be managed based on the status of the fish they affect. NMFS' objective is to develop a long-term abundance-based management plan that is more responsive to interannual changes in fish abundance. Once completed, the plan could provide the basis for a programmatic biological opinion that would cover the management of fall season fisheries for the foreseeable future. Based on these considerations, NMFS concludes that the impacts associated with the proposed 2004 fisheries are not likely to appreciably reduce the likelihood of survival and recovery of Lower Columbia River, Middle Columbia River, Snake River, or Upper Columbia River steelhead ESUs.

6.0 CONCLUSION

After reviewing the current status of the listed ESUs considered in this biological opinion, the environmental baseline for the action area, the effects of the proposed fisheries, and the cumulative effects, it is NMFS' biological opinion that the proposed 2004 fall season fisheries are not likely to jeopardize the continued existence of the Snake River or Lower Columbia River chinook salmon; Columbia River chum salmon; Lower Columbia River coho salmon; or Lower Columbia River, Middle Columbia River, Snake River, or Upper Columbia River steelhead ESUs.

The designated critical habitat for Snake River fall chinook and the essential habitat features for the other ESUs considered in the biological opinion are not substantially affected by the proposed fisheries. The activities considered in this consultation will therefore not result in the destruction or adverse modification of any of the essential features of designated critical habitat.

7.0 INCIDENTAL TAKE STATEMENT

Section 9 of the ESA and Federal regulations pursuant to section 4(d) of the ESA prohibit the take of endangered and threatened species, respectively, without special exemption. " Take" is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. "Harm" is further defined to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing behavioral patterns, including breeding, feeding, or sheltering. "Harass" is defined as intentional or negligent actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding, or sheltering. "Incidental take" is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the ESA provided that such taking is in compliance with the terms and conditions of this Incidental Take Statement (ITS).

The measures described below are non-discretionary; they must be undertaken by the action agency so that they become binding conditions of any grant or permit issued to the applicant, as appropriate, in order for the exemption in section 7(o)(2) to apply. The action agencies have a continuing duty to regulate the activity covered in this incidental take statement. If the action agencies (1) fail to assume and implement the terms and conditions or (2) fail to require the applicant to adhere to the terms and conditions of the incidental take statement through enforceable terms that are added to the permit or grant document, the protective coverage of section 7(o)(2) may lapse. In order to monitor the impact of incidental take, the agencies must report the progress of the action and its impact on the species to NMFS as specified in the incidental take statement. [50 CFR §402.14(I)(3)]

An incidental take statement specifies the impact of any incidental taking of endangered or threatened species. It also provides reasonable and prudent measures that are necessary to minimize impacts and sets forth terms and conditions with which the action agency must comply in order to implement the reasonable and prudent measures.

7.1 Amount or Extent of Incidental Take Anticipated

NMFS anticipates that the ESA listed species will be taken as a result of fall season fisheries. The incidental take occurs as a result of catch and retention, or mortalities resulting from catch and release, or mortalities resulting from encounter with fishing gear, as a consequence of fishing activity. The amount of anticipated take is expressed below in terms of harvest rates.

7.1.1 Chinook Salmon

The maximum allowed harvest rate for Snake River fall chinook is 31.29%. The expected harvest rates on Snake River fall chinook in proposed treaty Indian and non-Indian fisheries are 8.25% and 23.04%, respectively. However, this distribution of harvest impacts may vary inseason.

The tribal fisheries are not expected to affect the Lower Columbia River chinook ESU. There will be no effect to the spring component of the Lower Columbia River ESU in the proposed non-Indian fisheries. The expected harvest rates on the tule and bright components of the Lower Columbia River chinook ESU in the non-Indian fisheries are 12.4% and 11.8%, respectively. However, harvest rates to the Lower Columbia River stock components may vary inseason. The proposed fall season fisheries are subject to a combined ocean and inriver RER for Lower Columbia River tules of 49%. The impacts to Lower Columbia River chinook stocks in non-Indian fisheries will be constrained primarily by the harvest rate limits for Snake River fall chinook and steelhead.

7.1.2 Chum Salmon

The expected incidental take of Lower Columbia River chum in the proposed treaty Indian fisheries is zero. The incidental harvest rate on Lower Columbia River chum for the proposed non-Indian fishery is ≤5%, with an expected incidental harvest rate of 1.6%.

7.1.3 Lower Columbia Coho Salmon

The expected harvest rate on natural origin Lower Columbia River coho in the proposed non-Indian and treaty Indian fisheries is 6.4% and 0%, respectively.

7.1.4 Steelhead

The combined harvest rate of all proposed treaty Indian fisheries on Lower Columbia River and Middle Columbia River (hatchery and natural-origin) steelhead are 0.1% and 3.4%, respectively. The expected harvest rates on Upper Columbia River natural and hatchery-origin steelhead are 3.4% and 5.7%, respectively. The expected harvest rates on Snake River A and B-run steelhead are 3.4% and 13.6%, respectively. These harvest rates may increase or decrease in season, but are limited by the treaty Indian incidental harvest rate on Snake River B-run steelhead that may not exceed 15%.

The incidental mortality of natural-origin steelhead from the Lower Columbia River, Middle Columbia River, Upper Columbia River, and Snake River ESUs resulting from the proposed non-Indian fisheries is subject to a harvest rate limit of ≤2% for all ESUs. The incidental mortality of natural-origin steelhead from hatchery-origin Upper Columbia River steelhead a harvest rate of 10.9%. The expected incidental harvest rates for non-Indian fisheries are expected to be lower than the prescribed limits of steelhead ESUs (Table 10).

7.2 Effect of the Take

In this biological opinion, NMFS has determined that the level of take anticipated is not likely to jeopardize the continued existence of ESA listed salmonid species or result in the destruction or adverse modification of designated critical habitat.

7.3 Reasonable and Prudent Measures

NMFS concludes that the following reasonable and prudent measures are necessary and appropriate to minimize the impacts from fisheries considered in this biological opinion to listed steelhead and salmon ESUs.

1. The Washington Department of Fish and Wildlife (WDFW) shall monitor the passage of salmonids at Columbia River dams. The TAC shall provide necessary inseason estimates of run size.

2. The WDFW and the Oregon Department of Fish and Wildlife (ODFW) shall monitor the catch for recreational and commercial fisheries in Zones 1-6.

3. The WDFW and the ODFW shall sample the recreational and commercial fisheries in Zones 1-6 for stock composition.

4. The Columbia River Inter-tribal Fish Commission (CRITFC) and its member tribes shall monitor the catch in all tribal ceremonial and subsistence (C&S) fisheries and platform fisheries, and in commercial fisheries in cooperation with the monitoring efforts of the states.

5. The CRITFC and its member tribes shall sample the Zone 6 C&S fishery sufficient for stock composition.

6. The TAC shall account for the catch of each fishery as it occurs through the season and report to NMFS the results of these monitoring activities and, in particular, any anticipated or actual increases in the incidental harvest rates of listed species from those expected preseason.

7.4 Terms and Conditions

In order to be exempt from the prohibitions of section 9 of the ESA, the action agencies must ensure that the tribes and states comply with the following terms and conditions, which implement the reasonable and prudent measures described above. These terms and conditions are non-discretionary.

1. The WDFW shall obtain daily counts of all salmonids passing Bonneville, The Dalles, John Day, and McNary dams. The TAC shall use dam counts and other available information to develop inseason updates to run size estimates for fall chinook and steelhead.

2. Monitoring of catch in the recreational and Zone 1-6 commercial fisheries by WDFW and ODFW shall be sufficient to provide statistically valid estimates of the salmon and steelhead catch. Sampling of the commercial catch shall entail daily contact with buyers regarding the catch of the previous day. The recreational fishery shall be sampled using effort surveys and suitable measures of catch rate.

3. The WDFW and the ODFW shall sample the stock composition of the recreational fisheries and Zone 1-6 commercial fisheries at a sampling rate of 20%.

4. Monitoring of catch in the Zone 6 fisheries by CRITFC and its member tribes shall be sufficient to provide statistically valid estimates of the catch of salmon and steelhead. The catch monitoring program shall be stratified to include platform, hook-and-line, and gillnet fishery components.

5. The CRITFC and its member tribes shall sample the stock composition of the Zone 6 C&S fisheries at a sampling rate of 20%.

6. The TAC shall account for the daily catch of each fishery through the season. If it becomes apparent inseason that any of the established harvest rate limits may be exceeded due to catch or revisions in the run-size projection, then the states and tribes shall take additional management measures to reduce the anticipated catch as needed to conform to the limits.

8.0 CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the ESA directs Federal agencies to utilize their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of threatened and endangered species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information. NMFS believes the following conservation recommendations should be implemented:

1. Restrictions on harvest for protection of natural-origin steelhead will reduce the tribes' ability to access harvestable fall chinook and hatchery steelhead using traditional fishing methods. The U.S. v Oregon parties, including the federal government, the tribes, and the states, should work to develop alternative fishing methods that reduce impacts to wild steelhead while more selectively targeting harvestable stocks. The alternative is to limit mixed stock fisheries according to the conservation needs of the weak stocks and thereby forego the catch of otherwise harvestable fish. Methods to be evaluated should include, but not necessarily be limited to:

   a. Modifications to net types used in the mainstem Columbia River, with the intent to either avoid the encounter of certain species through maximum or minimum mesh size regulations, or to increase the ability to release nontarget fish unharmed through use of tangle nets, tooth nets, or other similar gear. A multi-year fishery evaluation by the Yakama Indian Nation suggests that the use of minimum mesh size regulation may be quite effective in selectively catching chinook salmon while reducing impacts to steelhead in mainstem fisheries. Available information suggests that the use of "weedline" gear which incorporates a panel of large mesh at the top of a gillnet is effective in avoiding steelhead which migrate close to the surface. Recent studies on the use of tooth nets for selective commercial harvest indicate catch-and-release survival rates are low enough at least during spring season fisheries to provide fisheries and conservation benefits. These and other similar approaches should be evaluated. Funding needs for research and, if warranted, implementation, and appropriate funding sources, should be identified.

b. Catch-and-release of unmarked steelhead should be implemented in tribal dipnet and hoopnet fisheries. In the 1998 mainstem Columbia River fall season fishery, an estimated 42 wild-A and 380 wild-B steelhead were taken in the treaty Indian platform ceremonial and subsistence fishery. Had the platform fishery been implemented with a regulation requiring live release of unmarked steelhead, a savings of approximately 2½ percentage points in the overall wild-B steelhead harvest rate would have resulted. Additional opportunities for dipnet and hoopnet fisheries in tributary areas, particularly in areas with runs dominated by hatchery returns, should be sought or developed, with the additional benefit that such sites are likely to be much closer to or actually on tribal lands.

c. The potential use of fish traps and fish wheels, or other live capture methods, in the mainstem Columbia River, in off-mainstem areas, and in tributaries should be carefully considered. In some cases, both technical and regulatory constraints to the use of such gear exist. In particular, the potential catch of traps and fish wheels is highly site-specific, and appropriate locations in the mainstem may not exist. However, the high selectivity of such gear, including the extremely low mortality rates apparently associated with catch-and-release of nontarget species indicate that such gear types merit further evaluation.

2. The mortality risks associated with the handling and live release of salmonids in fisheries are exacerbated by stresses associated with warm water conditions. At water temperatures above approximately 70˚ F, biological functions are impaired and fish die as a direct result of high temperatures (Environmental Protection Agency 1971). Even at somewhat lower temperatures, while salmon may not suffer significant mortalities as a direct result of handling, metabolic stresses increase the susceptibility of individuals to other adverse effects, and additional stresses from other sources which cumulatively increase the likelihood of mortality (Wilkie et al. 1996; Wydoski et al. 1976; Bell 1990). The probability of hooking mortality of adult summer steelhead angled in the Mad and North Fork Trinity Rivers increased markedly (from less than 5% to nearly 45%) when water temperatures increased from 18˚C to 25˚C (G. Taylor, ODFW, pers. comm., to H. Pollard, NMFS, August 17, 1998). Mortality of rainbow trout played to exhaustion has been shown to significantly increase with increases in water temperature (Dotson 1982).

An additional concern associated with high mainstem water temperatures involves fisheries in cold water refugia, such as the mouths of Herman Creek and the Klickitat River and Drano

Lake. Current recreational fishery regulations based on average estimated encounter rates may be substantially in error when actual encounter rates in fisheries with significant effort are much higher. When water temperatures in larger river main stems increase, upstream-migrating adult salmonids "dip in" to the mouth of tributaries, where temperatures are lower. The fish concentrate in these areas and hold until mainstem temperatures begin to decrease. As a result of the assemblages of fish, fisheries also tend to intensify in these tributary areas, with several potential adverse effects: the fisheries are more concentrated; the hooking rate per fish may increase; and the fish are already likely to be debilitated from warm water effects. The resultant damage to migrating stocks of salmonids is potentially high, and may require significant reduction of fishing in these refugia areas during adult migration to protect spawning escapements upstream.

The extent to which warm water actually increases mortality rates in Columbia River fisheries is unclear, but significant benefits to salmonid rebuilding and recovery may be available through additional fishery management actions designed to address high water temperatures. For example, in response to similar concerns, the State of Maine's Conservation Plan recommends that catch-and-release fisheries on Atlantic salmon be closed during periods of water temperatures in excess of 68˚F (20˚C)(The Maine Atlantic Salmon Task Force 1997). The U.S. v. Oregon Federal, tribal, and state fishery co-managers should explore and develop actions addressing the following concerns:

a. The Federal, tribal, and state fishery agencies should compile and evaluate existing data on temperature effects on salmonid survival, and identify and implement additional research needed to identify whether fishery constraints during warm water periods are warranted, and, if so, at what temperature such constraints should be applied.

b. The states of Oregon, Washington, and Idaho should explore criteria for application and the potential for recreational fishery regulations restricting fisheries during periods of excessively high water temperatures. The tribes should explore similar criteria for tribal gillnet restrictions during periods of warm water, to decrease mortalities accruing to non-target steelhead encountering but escaping from gillnets, particularly large-mesh nets used to reduce impacts to steelhead.

c. The tribes and states should consider closing all cold water refugia to fishing activities during periods of excessively high mainstem water temperatures.

d. The parties should develop information outreach programs to instruct fishers on the implications of fishing during warm water conditions. This education should address the need to reduce fight time and other undue sources of fishing stress by landing fish quicker, using gear of greater strength, and by leaving in the water any fish intended to be released.

9.0 REINITIATION OF CONSULTATION

This concludes formal consultation on the 2004 fall season fisheries in the Columbia River basin. As provided in 50 CFR §402.16, reinitiation of formal consultation is required where discretionary federal agency involvement or control over the action has been retained (or is authorized by law) and if: (1) the amount or extent of incidental take is exceeded; (2) new information reveals effects of the action that may affect listed species or critical habitat in a manner or to an extent not previously considered; (3) the identified action is subsequently modified in a manner that causes an effect to listed species or critical habitat that was not considered in the biological opinion; (4) a new species is listed or critical habitat designated that may be affected by the identified action. In instances where the amount or extent of incidental take is exceeded, any operations causing such take must cease pending reinitiation.

NMFS finds the management constraints contained in this biological opinion necessary for the conservation of the affected listed species. In arriving at these management constraints, NMFS has been mindful of affected treaty rights and its Federal trust obligations. NMFS will reconsider the management constraints in this biological opinion that affect treaty rights in the event new information indicates such reconsideration is warranted.

This concludes the conference on the 2004 fall season fisheries in the Columbia River basin. You may ask the Service to confirm the conference opinion as a biological opinion issues through formal consultation if Lower Columbia River coho salmon is listed or critical habitat designated. The request must be in writing. If the Service reviews the proposed action and finds that there have been no significant changes in the action as planned or in the information used during the conference, the Service will confirm the conference opinion as the biological opinion on the project and no further consultation will be necessary.

After listing of Lower Columbia River coho salmon as endangered/threatened and/or designation of its critical habitat, and any subsequent adoption of this conference opinion, the Federal agency shall request reinitiation of consultation if: (1) the amount or extent of incidental take is exceeded; (2) new information reveals effects of the agency action that may affect the species or critical habitat in a manner or to an extent not considered in the conference opinion; (3) the agency action is subsequently modified in a manner that causes the effects to Lower Columbia River coho salmon or its critical habitat that was not considered in the conference opinion; or (4) new species is listed or critical habitat designated that may be affected by the action.

The incidental take statement provided in this conference opinion does not become effective until Lower Columbia River coho salmon is listed and the conference opinion is adopted as the biological opinion issued through formal consultation. At that time, the project will be reviewed to determine whether any take of Lower Columbia River coho salmon or adverse modification of its critical habitat has occurred. Modification of the opinion and incidental take statement may be appropriate to reflect that take. No take of Lower Columbia River coho salmon or adverse modification of its critical habitat may occur between its listing and the adoption of the conference opinion through formal consultation, or the completion of a subsequent formal consultation.

10.0 MAGNUSON-STEVENS ACT ESSENTIAL FISH HABITAT CONSULTATION

The MSA, as amended by the Sustainable Fisheries Act of 1996 (Public Law 104-267), established procedures designed to identify, conserve, and enhance EFH for those species regulated under a Federal fisheries management plan. Pursuant to the MSA:

- Federal agencies must consult with NMFS on all actions, or proposed actions, authorized, funded, or undertaken by the agency, that may adversely affect EFH (§305(b)(2));
- NMFS must provide conservation recommendations for any Federal or State action that would adversely affect EFH (§305(b)(4)(A)); and
- Federal agencies must provide a detailed response in writing to NMFS within 30 days after receiving EFH conservation recommendations. The response must include a description of measures proposed by the agency for avoiding, mitigating, or offsetting the impact of the activity on EFH. In the case of a response that is inconsistent with NMFS EFH conservation recommendations, the Federal agency must explain its reasons for not following the recommendations (§305(b)(4)(B)).

EFH means those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity (MSA §3). For the purpose of interpreting this definition of EFH: Waters include aquatic areas and their associated physical, chemical, and biological properties that are used by fish and may include aquatic areas historically used by fish where appropriate; substrate includes sediment, hard bottom, structures underlying the waters, and associated biological communities; necessary means the habitat required to support a sustainable fishery and the managed species' contribution to a healthy ecosystem; and "spawning, breeding, feeding, or growth to maturity" covers a species' full life cycle (50 CFR 600.10). Adverse effect means any impact which reduces quality and/or quantity of EFH, and may include direct (*e.g.*, contamination or physical disruption), indirect (*e.g.*, loss of prey or reduction in species fecundity), site-specific or habitat-wide impacts, including individual, cumulative, or synergistic consequences of actions (50 CFR 600.810).

EFH consultation with NMFS is required regarding any Federal agency action that may adversely affect EFH, including actions that occur outside EFH, such as upstream and upslope activities that may adversely affect EFH.

The objectives of this EFH consultation are to determine whether the proposed action would adversely affect designated EFH and to recommend conservation measures to avoid, minimize, or otherwise offset potential adverse effects to EFH.

10.1 Identification of Essential Fish Habitat

Pursuant to the MSA, the Pacific Fisheries Management Council (PFMC) has designated EFH for three species of federally-managed Pacific salmon: chinook (*O. tshawytscha*); coho (*O. kisutch*); and Puget Sound pink salmon (*O. gorbuscha*)(PFMC 1999). Freshwater EFH for Pacific salmon includes all those streams, lakes, ponds, wetlands, and other water bodies currently, or historically accessible to salmon in Washington, Oregon, Idaho, and California, except areas upstream of certain impassable man-made barriers (as identified by the PFMC 1999), and longstanding, naturally-impassable barriers (i.e., natural waterfalls in existence for several hundred years). Detailed descriptions and identifications of EFH for salmon are found in Appendix A to Amendment 14 to the Pacific Coast Salmon Plan (PFMC 1999). Assessment of potential adverse effects to these species' EFH from the proposed action is based, in part, on this information.

10.2 Proposed Action and Action Area

For this EFH consultation, the proposed action and action area are as described in detail above. The proposed action is the issuance of an incidental take statement pursuant to section 7 of the ESA with respect to the 2004 fall season fisheries in the Columbia River basin as forwarded by the Parties. The action area includes the Columbia River from its mouth upstream to the Wanapum Dam, including its tributaries (with the exception of the Willamette River). The action area includes habitats that have been designated as EFH for various life-history stages of chinook and coho salmon. A more detailed description and identification of EFH for salmon is found in Appendix A to Amendment 14 to the Pacific Coast Salmon Plan (PFMC 1999). Assessment of the impacts on these species' EFH from the above proposed action is based on this information.

10.3 Effects of the Proposed Action

While harvest related activities do affect passage in that fish are intercepted, those impacts are accounted for explicitly in the ESA analyses regarding harvest related mortality. Most of the harvest related activities occur from boats or along river banks. Gears that are used include primarily hook-and-line, drift and set gillnets, and hoop nets that do not substantially affect the habitat. There will be minimal disturbance to vegetation, and negligible harm to spawning or rearing habitat, or to water quantity and water quality. Thus, there will be minimal effects on the essential habitat features of the affected species from the action discussed in this biological opinion, certainly not enough to contribute to a decline in the values of the habitat.

10.4 Conclusion

Using the best scientific information, including information supplied by the TAC, NMFS' analysis in the above ESA consultation, as well as the foregoing EFH sections, NMFS has determined that the proposed action is not likely to adversely affect designated Pacific salmon EFH.

10.5 EFH Conservation Recommendation

Pursuant to Section 305(b)(4)(A) of the MSA, NMFS is required to provide EFH conservation recommendations to Federal agencies regarding actions which may adversely affect EFH. Because NMFS concludes that the proposed Federal action would not adversely affect designated EFH, it will not issue additional specific conservation recommendations.

10.6 Statutory Response Requirement

Because there are no conservation recommendations, there are no statutory response requirements.

10.7 Consultation Renewal

NMFS must reinitiate EFH consultation if the proposed 2004 fall season fisheries in the Columbia River basin are substantially revised in a way that may adversely affect EFH, or if new information becomes available that affects the basis for the EFH conservation recommendations (50 CFR Section 600.920(k)).

11.0 DATA QUALITY ACT DOCUMENTATION AND PRE-DISSEMINATION REVIEW

Section 515 of the Treasury and General Government Appropriations Act of 2001 (Public Law 106-554) ("Data Quality Act") specifies three components contributing to the quality of a document. They are utility, integrity, and objectivity. This section of the Biological Opinion addresses these DQA components, documents compliance with the Data Quality Act, and certifies that this Biological Opinion has undergone pre-dissemination review.

Utility: This ESA section 7 consultation on proposed U.S. v. Oregon 2004 fall season fisheries in the Columbia River will not jeopardize the affected ESUs. NMFS can therefore write a no-jeopardy Biological Opinion exempting from prohibition the incidental take of ESA-listed species during conduct of this suite of fall season fisheries in accordance with the 2004 management agreement (U.S. v Oregon Parties 2004). The intended users are the U.S. v Oregon Parties and their respective communities. Tribal members, recreational fishers and associated businesses, commercial fishers, fish buyers and related food service industries, and the general public benefit from the consultation.

Copies of the Biological Opinion were provided to the U.S. v Oregon Parties. This consultation will be posted on the NMFS NW Region web site (*www.nwr.noaa.gov*). The format and naming adheres to conventional standards for style.

Integrity: This consultation was completed on a computer system managed by NMFS in accordance with relevant information technology security policies and standards set out in Appendix III, "Security of Automated Information Resources," Office of Management and Budget Circular A-130; the Computer Security Act; and the Government Information Security Reform Act.

Objectivity:

Information Product Category: Natural Resource Plan.

Standards: This consultation and supporting documents are clear, concise, complete, and unbiased, and were developed using commonly accepted scientific research methods. They adhere to published standards including the NMFS ESA Consultation Handbook, ESA Regulations (50 CFR 402.01 et seq.), and the Magnuson-Stevens Fishery Conservation and Management Act (MSA) implementing regulations regarding Essential Fish Habitat (50 CFR 600.920(j)).

Best Available Information: This consultation and supporting documents use the best available information, as referenced in the literature cited section. The analyses in this Biological Opinion/EFH consultation contain more background on information sources and quality.

Referencing**:** All supporting materials, information, data, and analyses are properly referenced, consistent with standard scientific referencing style.

Review Process: This consultation was drafted by NMFS staff with training in ESA and MSA implementation, and reviewed in accordance with Northwest Region ESA quality control and assurance processes.

12.0 REFERENCES

Bell, M.C. 1990. Fisheries handbook of engineering requirements and biological criteria. Fish Passage Development and Evaluation Program, U.S. Army Corps of Engineers.

Biological Requirements Work Group (BRWG). 1994. Analytical methods for determining requirements of listed Snake River salmon relative to survival and recovery. Progress Report, October 13, 1994. 129 p w/ Appendices.

Biological Review Team. 2003. Updated status of Federally listed ESUs of west coast salmon and steelhead. West coast salmon Biological Review Team. July 2003.

Busby, P.J., T.C. Wainwright, G.J. Bryant, L.J. Lierheimer, R.S. Waples, F.W. Waknitz, and I.V. Lagomarsino. 1996. Status review of west coast steelhead from Washington, Idaho, Oregon, and California. U.S. Dept. Commer., NOAA Tech. Memo. NMFS-NWFSC-27. 261p.

Cichosz, T., D. Saul, A. Davidson, W. Warren, D. Rollins, J. Willey, T. Tate, T. Papanicolaou and S. Juul. 2001. Clearwater Subbasin Summary. Draft submitted to the Northwest Power Planning Council. Nov. 2001. 477 p.

Collis, K., S. Adamany, D. D. Roby, D. P. Craig, and D. E. Lyons. 1999. Avian predation on juvenile salmonids in the lower Columbia River. Report to Bonneville Power Administration and U.S. Army Corps of Engineers. Columbia River Inter-Tribal Fish Commission, Portland, Oregon, and Oregon Cooperative Fish and Wildlife Research Unit, Oregon State University, Corvallis. October.

Columbia Basin Fish and Wildlife Authority (CBFWA). 1990.

Craig, J. A. and R. L. Hacker. 1940. The history and development of the fisheries of the Columbia River. U.S. Bureau of Fisheries Bulletin. 49(32):133-215.

Columbia River Intertribal Fish Commission (CRITFC). 1995. Wy-Kan-Ush-Me-Wa-Kish-Wit Spirit of the Salmon, The Columbia River Anadromous Fish Restoration Plan of the Nez Perce, Umatilla, Warm Springs, and Yakama Tribes. Portland, Oregon. 2 volumes. Available Online at: *http://www.critfc.org/text/work.html*

Dotson, T. 1982. Mortalities in trout caused by gear type and angler-induced stress. N. Amer. J. Fish. Manage. 2:60-65.

Doppelt, B., M. Scurlock, C. Frissell, and J. Karr. 1993. Entering the watershed: a new approach to save America's river ecosystems. Island Press, Washington D.C.

Federal Caucus. 2000. Conservation of Columbia River Fish: Final Basinwide Salmon Recovery strategy. December. http://www.samonrecovery.gov

Flagg, T. A., F. W. Waknitz, D. J. Maynard, G. B. Milner, and C.V.W. Mahnken. 1995. The effect of hatcheries on native coho salmon populations in the lower Columbia River. *In* Uses and effects of cultured fishes in aquatic systems. Transactions of the American Fisheries Society 15:366-375.

Ford, M., et al. 2001. Upper Columbia River steelhead and spring chinook salmon population structure and biological requirements. Final Report, March 2001. prepared by Upper Columbia River Steelehad and Spring Chinook Salmon Biological Requirements Committee. p. 64.

Frissell, C. A. 1993. A new strategy for watershed restoration and recovery of Pacific salmon in the Pacific Northwest. Prepared for the Pacific Rivers Council, Eugene, Oregon.

Fulton, L.A. 1968. Spawning areas and abundance of chinook salmon, *Oncorhynchus tshawytscha*, in the Columbia River Basin — past and present. U.S. Fish. Wildl. Serv. Spec. Sci. Rep. Fish. 571:26.

Greer, J.W. and J.P. Koenings. 2000a. Letter to W. Stelle, NMFS. May 1, 2000. 2 p. w/attached section 7/10 assessment/permit application.

Greer, J. and J. Koenings. 2000b. Letter to W. Stelle, NMFS. Re: Amendment to permit application. July 20, 2000. 1p.

Hare, S. R., N. J. Mantua and R. C. Francis. 1999. Inverse production regimes: Alaskan and West Coast Salmon. Fisheries 24(1):6-14.

Henjum, M. G., J. R. Karr, D. L. Bottom, D. A. Perry, J. C. Bednarz, S. G. Wright, S. A. Beckwitt, and E. Beckwitt. 1994. Interim Protection for late-successional forests, fisheries, and watersheds: national east of the Cascade Crest, Oregon and Washington. The Wildlife Society, Bethesda, Maryland.

Howell, P., K. Jones, D. Scarnecchia, L. LaVoy, W. Knedra, and D. Orrmann. 1985. Stock assessment of Columbia River anadromous salmonids. Vol. I. U.S. Dept. of Energy, Bonneville Power Administration. Project No. 83-335. 558p.

Hymer, J. 1993. Estimating the natural spawning chum population in the Grays River Basin, 1944-1991. Columbia River Lab. Prog. Rep. 93-17, 17 p. Wash. Dep. Fish. Wildl., Columbia River Lab., P.O. Box 999, Battle Ground, WA 98604.

Hymer, J. 1994. Estimating chum salmon population in Hardy Creek, 1957-1993. Columbia River Lab. Prog. Rep. 94-11, 15 p. Wash. Dep. Fish. Wildl., Columbia River Lab., P.O. Box 999, Battle Ground, WA 98604.

Idaho Department of Fish and Game (IDFG). 1992. Anadromous Fish Management Plan. 1992-1996. 217 p.

Independent Science Group (ISG). 1996. Return to the river: Restoration of salmonid fishes in the Columbia River ecosystem. Northwest Power Planning Council, Portland, Oregon. Publication No. 96-6. 584 pp.

Irving J. S. and T. Bjornn. 1991. A forecast of abundance of Snake River fall chinook salmon. Prepared for U.S. Fish & Wildlife Service. Unpubl. MS. 55 p. Available from Idaho Cooperative Fishery Research Unit. Univ. of Idaho, Moscow, ID.

Jackson, P.L. 1993. Climate. In P.L. Jackson and A.J. Kimerling (editors), Atlas of the Pacific Northwest, p. 48-57. Oregon State Univ. Press, Corvallis.

Jamison, B. 2000. Biological Assessment of the incidental impacts on salmonid species listed under the Endangered Species Act in the 2000 treaty Indian fall season fisheries in the Columbia River. 79p.

Joint Columbia River Management Staff (JCRMS). 2004. Joint staff report concerning the 2004 fall in-river commercail harvest of Columbia River fall Chinook salmon, summer steelhead, coho salmon , chum salmon, and sturgeon. Oregon Department of Fish and Wildlife and Washington Department of Fish and Wildlife. July 21, 2004. 66 pp.

Kostow, K. 1995. Biennial report on the status of wild fish in Oregon. Oreg. Dep. Fish Wildl. Rep., 217p. + app.

LeFleur, C. 2002. Memorandum re: U.S. v. Oregon, Fall Season 2002 Biological Assessment and Request for Section 7 Consultation, to P. Dygert, NMFS. July 2, 2002. p.1 w/ enclosure.

LeFleur, C. 2003. Memorandum re: U.S. v. Oregon, Fall Season 2003 Biological Assessment and Request for Section 7 Consultation, to P. Dygert, NMFS. June 10, 2003. p.1 w/ enclosure.

LeFleur, C. 2004. Memorandum re: U.S. v. Oregon, Fall Season 2004 Biological Assessment and Request for Section 7 Consultation, to P. Dygert, NMFS. June 9, 2004 p.1 w/ enclosure.

Lohn, B. 2002. Letter to F. L. Cassidy, Jr. Chairman, Northwest Power Planning Council. April 4, 2002. 2 p. w/ enclosure.

Lohn, D.R. and R. McInnis. 2004. Letter to D.K. Hansen, Chairman, Pacific Fisheries Management Council. March 5, 2004. 8 p. w/enclosure.

Lower Columbia River Estuary Program (LCREP) [abrv. In text also]. 1999. Comprehensive Conservation and Management Plan. Volume 1: June 1999. Lower Columbia River Estuary Program, Portland, Oregon.

Mallet, J. 1974. Inventory of salmon an steelhead resources, habitats, use and demands. Job Performance Report. Proj. F-58-R-1. Idaho Dept. of Fish and Game. Boise. Idaho.

Mantua, N.J. and S.R. Hare, Y. Zhang, J.M. Wallace, and R.C. Francis. 1997: A Pacific interdecadal climate oscillation with impacts on salmon production. Bulletin of the American Meteorological Society, 78, pp. 1069-1079.

Marshall, A.R., C. Smith, R. Brix, W. Dammers, J. Hymer, and L. LaVoy. 1995. Genetic diversity units and major ancestral lineages for chinook salmon in Washington. In C. Busack and J. B. Shaklee (eds.), Genetic diversity units and major ancestral lineages of salmonid fishes in Washington, p. 111-173. Wash. Dep. Fish Wildl. Tech. Rep. RAD 95-02. (Available from Washington Department of Fish and Wildlife, 600 Capital Way N., Olympia WA 98501-1091.)

McElhany, P. , M.H. Ruckelshaus, M.J. Ford, T.C. Wainwright, and E.P. Bjorkstedt. 2000. Viable salmonid populations and the recovery of evolutionarily significant units. U.S. Dept. Commer., NOAA Tech. Memo. NMFS-NWFSC-42, 156 p. http://www.nwfsc.noaa.gov/pubs/ .

McElhany, P., T. Backman, C. Busack, S. Heppell, S. Kolmes, A. Maule, J. Myers, D. Rawding, D. Shively, and C. Steward. 2002. Willamette/Lower Columbia Pacific salmonid viability criteria. Draft report from the Willamette/Lower Columbia Technical Recovery Team. December 2002.

Mealy, S. P. 1997. Letter regarding the State of Idaho's comments on the proposed listing of Snake River steelhead for protection under the federal Endangered Species Act. February 11, 1997. 1 p. w/ enclosure.

Miller, R.J., and E.L. Brannon. 1982. The origin and development of life-history patterns in Pacific salmon. In E.L. Brannon and E.O. Salo (eds.), Proceedings of the Salmon and Trout Migratory Behavior Symposium. Univ. Washington Press; Seattle, Washington.

Mullan, J.W., K.R. Williams, G. Rhodus, T.W. Hillman, and J.D. McIntyre. 1992. Production and habitat of salmonids in mid-Columbia River tributary streams. U.S. Fish and Wildlife Service Monograph I. 489 p.

Myers and 10 co-authors. 1998. Status review of chinook salmon from Washington, Idaho, Oregon, and California. U.S. Dept. of Commerce, NOAA Tech. Memo. NMFS-NWFSC-35. 443p.

Myers, J., C. Busack, D. Rawding, A. Marshall. 2002. Identifying historical populations of chinook and chum salmon and steelhead within the Lower Columbia River and Upper Willamette River Evolutionarily significant Units. Co-manager Review Draft. May 10, 2002. 70 p. w/appendices.

National Marine Fisheries Service (NMFS). 1991. Factors for decline. A supplement to the notice of determination for Snake River fall chinook salmon under the Endangered Species Act. June 1991. 55 p.

NMFS. 1995. Proposed recovery plan for Snake River salmon. March 1995.

NMFS. 1996a. Endangered Species Act - Section 7 Consultation. Biological Opinion. Impacts on listed Snake River salmon by fisheries conducted pursuant to the 1996-1998 management agreement for upper Columbia River fall chinook. July 31, 1998. 20 p.

NMFS. 1998. Endangered Species Act - Section 7 Consultation. Reinitiation of consultation to consider impacts to listed steelhead resulting from 1998 fall season fisheries conducted under the Columbia River Fish Management Plan and 1996-1998 Management Agreement. September 10, 1998. 20 p. w/ attachment.

NMFS. 1999a. Endangered Species Act - Reinitiated Section 7 Consultation - Approval of the Pacific Salmon Treaty by the U.S. Department of State and Management of the Southeast Alaska Salmon Fisheries Subject to the Pacific Salmon Treaty. NMFS, Protected Resources Division. November 9, 1999. 90 p. + figures.

NMFS. 1999b. Endangered Species Act - Section 7 Consultation. Biological opinion and Incidental Take Statement. 1999 treaty Indian and non-Indian fall season fisheries in the Columbia River basin. July 30, 1999. 67p.

NMFS. 2000a. Endangered Species Act - Reinitiated Section 7 Consultation - Effects of Pacific coast ocean and Puget Sound salmon fisheries during the 2000-2001 annual regulatory cycle. NMFS, Protected Resources Division. April 28, 2000. 99 p.

NMFS. 2000b. Endangered Species Act section 7 Biological Opinion on the reinitiation of consultation on operation of the federal Columbia River Power System, including juvenile fish transportation programs, and 19 Bureau of Reclamations projects in the Columbia Basin. December 2000.

NMFS. 2000c. Biological opinion. Impacts of treaty Indian and non-Indian year 2000 winter, spring, and summer season fisheries in the Columbia River basin, on salmon and steelhead listed under the Endangered Species Act.

NMFS. 2001a. Joint State Tribal Resource Management Plan Provided by the Washington Department of Fish and Wildlife and the Puget Sound Tribes For Salmon Fisheries Affecting Puget Sound Chinook Salmon Under Limit 6 of the 4(d) Rule - Determination Memo. Memo from B. Robinson to D. Darm. NMFS NW Region. April 26, 2001.

NMFS. 2001b. Biological Opinion. Impacts of the Interim Management Agreement for upriver spring chinook, summer chinook, and sockeye salmon and steelhead listed under the Endangered Species Act. March 21, 2001. 97p. Available at: http://www.nwr.noaa.gov/1sustfsh/biops.htm

NMFS 2003. A Joint State Tribal Resource Management Plan (RMP) submitted under Limit 6 of the 4(d) Rule by the Puget Sound Tribes and Washington Department of Fish and Wildlife for salmon fisheries and steelhead net fisheries affecting Puget Sound chinook salmon - Decision Memo. Memo from B. Robinson to D. Robert Lohn. NMFS NW Region. May 19, 2003.

NMFS 2004a. Salmonid Hatchery Inventory and Effects Evaluation Report. NOAA Fisheries Northwest Region Salmon Recovery Division. May 18, 2004. Available on the internet at: www.nwr.noaa.gov/1srd/Prop_Determins/.

Norman, G. and B. Tweit. 2001. ESA section 7/10 application for the incidental take of listed species in Washington and Oregon mainstem fisheries of the Columbia River August trough December, 2001.

ODFW (Oregon Department of Fish and Wildlfe). 1991. Grand Ronde river subbasin salmon and steelhead plan. Prepared for Northwest Power Planning Council. 129 pp.

Oregon Department of Fish and Wildlife and Washington Department of Fish and Wildlife. 2000. Status Report. Columbia River Fish Runs and Fisheries, 1938-1999. 309 p.

Overberg, K. 2001. Biological Assessment of the incidental impacts on salmonid species listed under the Endangered Species Act in the 2001 treaty Indian fall season fisheries in the Columbia River. 97p w/tables.

PFMC (Pacific Fisheries Management Council). 1999. Amendment 14 to the Pacific Coast Salmon Plan. Appendix A: Description and Identification of Essential Fish Habitat, Adverse Impacts and Recommended Conservation Measures for Salmon. Pacific Fishery Management Council, Portland, Oregon.

PFMC. 2002. Review of 2001. Ocean Salmon Fisheries. Pacific Fishery Management Council. February 2002.

PFMC. 2003b. Preseason Report III Analysis of Council Adopted Management Measures for 2003 Ocean Salmon Fisheries. April 2003.

Pacific Salmon Commission (PSC). 2003. Annual Exploitation Rate Analysis and Model Calibration Report TCHINOOK (03)-2. November 28, 2003. 55 p. w/ Appendices.

Phelps, S.R., S.A. Leider, P.L. Hulett, B.M. Baker, and T. Johnson. 1997. Genetic analyses of Washington steelhead: preliminary results incorporating 36 new collections from 1995 and 1996. Washington Dept. of Fish and Wildlife. February 1997.

Pitcher, T.J. 1986. Functions of shoaling in teleosts. In Fisher, T.J. (ed.), The behavior of teleost fishes, p. 294-337. Johns Hopkins Univ. Press, Baltimore, MD.

Quigley, T. M., and S. J. Arbelbide (eds). 1997. An assessment of ecosystem components in the interior Columbia River basin and portions of the Klamath and Great Basins: Volume 3. Gen. Tech. Rep. PNW-GTR-405. Portland, Oregon: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 4 vol. (Quigley T. M., tech. ed.: The Interior Columbia Basin Ecosystem Management Project: Scientific Assessment).

Randall, R.G., M.C. Healey, and J.B. Dempson. 1987. Variability in length of freshwater residence of salmon, trout, and char. In Dodswell, M.J., et al. (eds.), Common strategies of anadromous and catadromous fishes. Am. Fish. Soc. Symp. 1:27-41.

Reimers, P.E., and R.E. Loeffel. 1967. The length of residence of juvenile fall chinook salmon in selected Columbia River tributaries. Fish Comm. Oreg. 13, 5-19 p.

Roby, D. D., D. P. Craig, K. Collis, and S. L. Adamany. 1998. Avian predation on juvenile salmonids in the lower Columbia River. Report to Bonneville Power Administration and U.S. Army Corps of Engineers. Oregon Cooperative Fish and Wildlife Research Unit, Corvallis, and Columbia River Inter-Tribal Fish Commission, Portland, Oregon. September revision.

Salo, E.O. 1991. Life history of chum salmon, Oncorhynchus keta. In Groot, C., and L. Margolis (eds.), Pacific salmon life histories, p. 231-309. Univ. B.C. Press, Vancouver, B.C., Canada.

Spence, B. C., G. A. Lomnicky, R. M. Hughes, and R. P. Novitzki. 1996. An ecosystem approach to salmonid conservation. Prepared by Management Technology for the National Marine Fisheries Service. TR-4501-96-6057. (Available from the NMFS Habitat Branch, Portland, Oregon.)

Standford, J. A., and J. V. Ward. 1992. Management of aquatic resources in large catchments: recognizing interactions between ecosystem connectivity and environmental disturbance. Pages 91-124 *in* R. J. Naiman, editor. Watershed management: balancing sustainability and environmental change. Springer-Verlag, New York.

Technical Advisory Committee (TAC). 1997. 1996 All species review - summer steelhead: Columbia River Fish Management Plan. August 4, 1997. 17 p. w/ tables, tables 8-11 updated.

TAC. 1999. Recommendations for fall chinook and steelhead management in mainstem Columbia River fisheries - draft. June 22, 1999. 2 p.

TAC. 2002. Escapement Estimates of Naturally Spawning Steelhead in the Snake Basin. Final Draft Report. December 2002. 47 p. w/ appendix.

The Maine Atlantic Salmon Task Force. 1997. Atlantic Salmon Conservation Plan for Seven Maine Rivers. March 1997.

Thomas, D. W. 1981. Historical analysis of the Columbia River estuary: An ecological approach. Draft report to the Columbia River Estuary Study Taskforce.

U.S. v. Oregon Parties. 2000. 2000 Management Agreement for Upper Columbia River fall chinook, steelhead and coho.

U.S. v. Oregon Parties. 2001. 2001 Management Agreement for Upper Columbia River fall chinook, steelhead and coho. Final Draft. 42 p.

U.S. v. Oregon Parties. 2002. 2002 Management Agreement for Upper Columbia River fall chinook, steelhead and coho. Final Draft. 41 p.

U.S. v. Oregon Parties. 2003. 2003 Management Agreement for Upper Columbia River fall chinook, steelhead and coho. Final Draft. 41 p.

U.S. v. Oregon Parties. 2004. 2004 Management Agreement for Upper Columbia River fall chinook, steelhead and coho. Final Draft. 42 p.

Utter, F., G. Milner, G. Stahl, and D. Teel. 1989. Genetic population structure of chinook salmon (*Oncorhynchus tshawytscha*), in the Pacific Northwest. Fish. Bull. 87:239-264.

WDF (Washington Department of Fisheries), Washington Department of Wildlife (WDW), and Western Washington Treaty Indian Tribes (WWTIT). 1992. 1992 Washington State salmon and steelhead stock inventory (SASSI). Wash. Dep. Fish Wildl., Olympia, 212 p. + 5 regional volumes. (Available from Washington Department of Fish and Wildlife, 600 Capitol Way N., Olympia, WA 98501-1091.)

Washington Department of Fisheries (WDF), Washington Department of Wildlife, and Western Washington Treaty Indian Tribes. 1993. 1992 Washington Statesalmon and steelhead stock inventory (SASSI). Wash. Dep. Fish Wildl., Olympia, 212p. + 5 regional volumes.

Washington Department of Fisheries (WDF) and Washington Department of Wildlife (WDW). 1993. 1992 Washington State salmon and steelhead stock inventory - Appendix three Columbia River stocks. June 1993. 580 p.

Washington Department of Fish and Wildlife (WDFW). 2001. Fisheries Management and Evaluation Plan - Lower Columbia River. February 21, 2001. 62 p. w/ appendices.

Waples, R. S. 1991. Pacific salmon, Oncorhynchus spp., and the definition of "species" under the Endangered Species Act. Marine Fisheries Review 53:11-22.

Waples, R.S., R.P. Jones Jr, B.R. Beckman, and G.A. Swan. 1991. Status review for Snake River fall chinook salmon. U.S. Department of Commerce, NOAA Technical Memorandum NMFS F/NWC-201. 73 p.

Wilkie, M.P., and 6 co-authors. 1996. Physiology and survival of wild Atlantic salmon following angling in warm summer waters. Trans. Amer. Fish. Soc. 125:572-580.

Wydoski, R.S., G.A. Wedemeyer, and N.C. Nelson. 1976. Physiological response to hooking stress in hatchery and wild rainbow trout (*Salmo gairdneri*). Trans. Amer. Fish. Soc. 105: 601-606.

Zhou and Chilcote 2004. Stock Assessment and Population Viability Analysis of Clackamas River Coho Salmon. June 2004. 35pp.